

Popular Science®

The **What's New** magazine

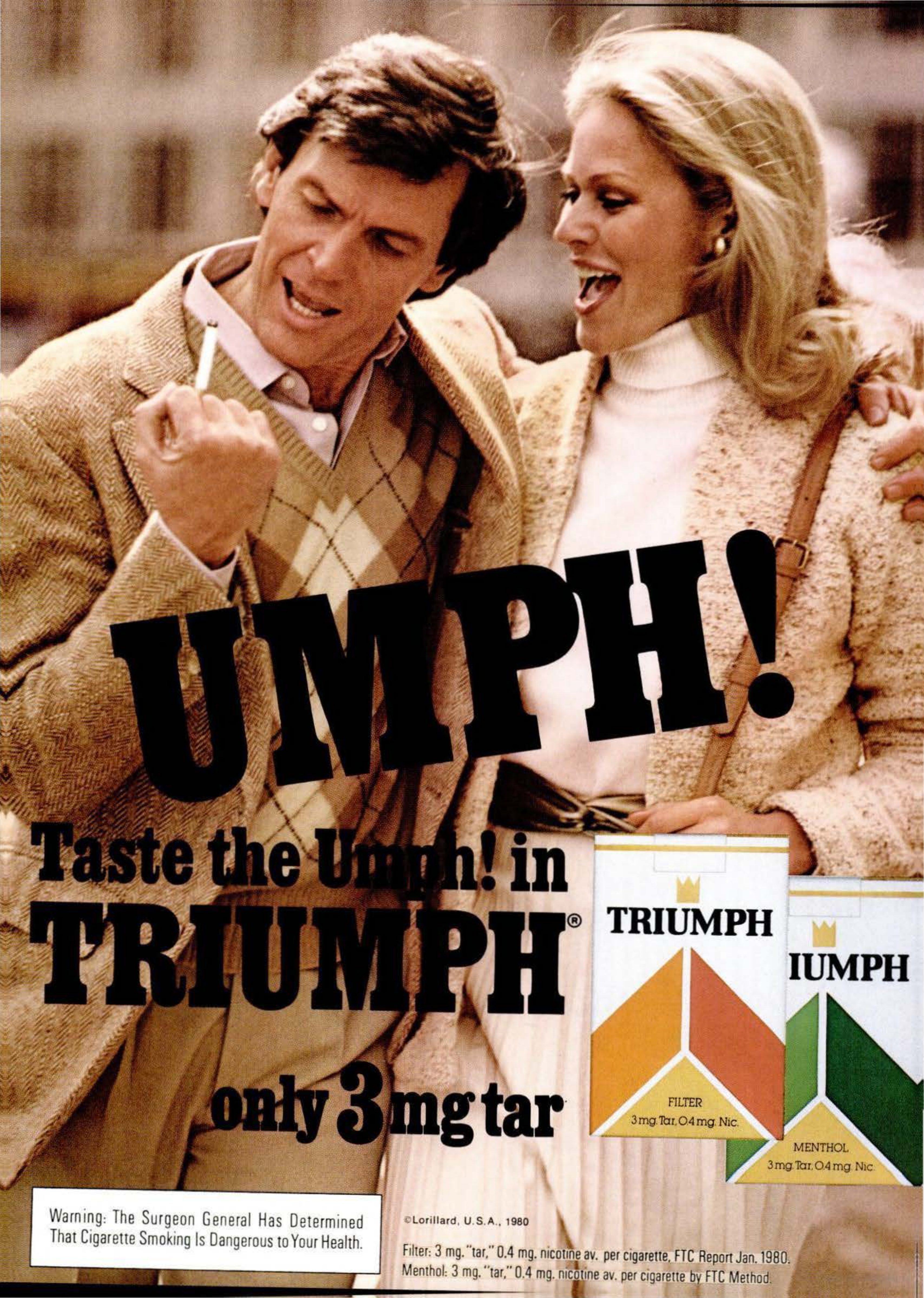
\$1.50
JUNE
1981

Almost here:
**FLAT-
SCREEN TV**

Satellite
report:

**Solving
the
mystery
of the
sun's
violent
flares**

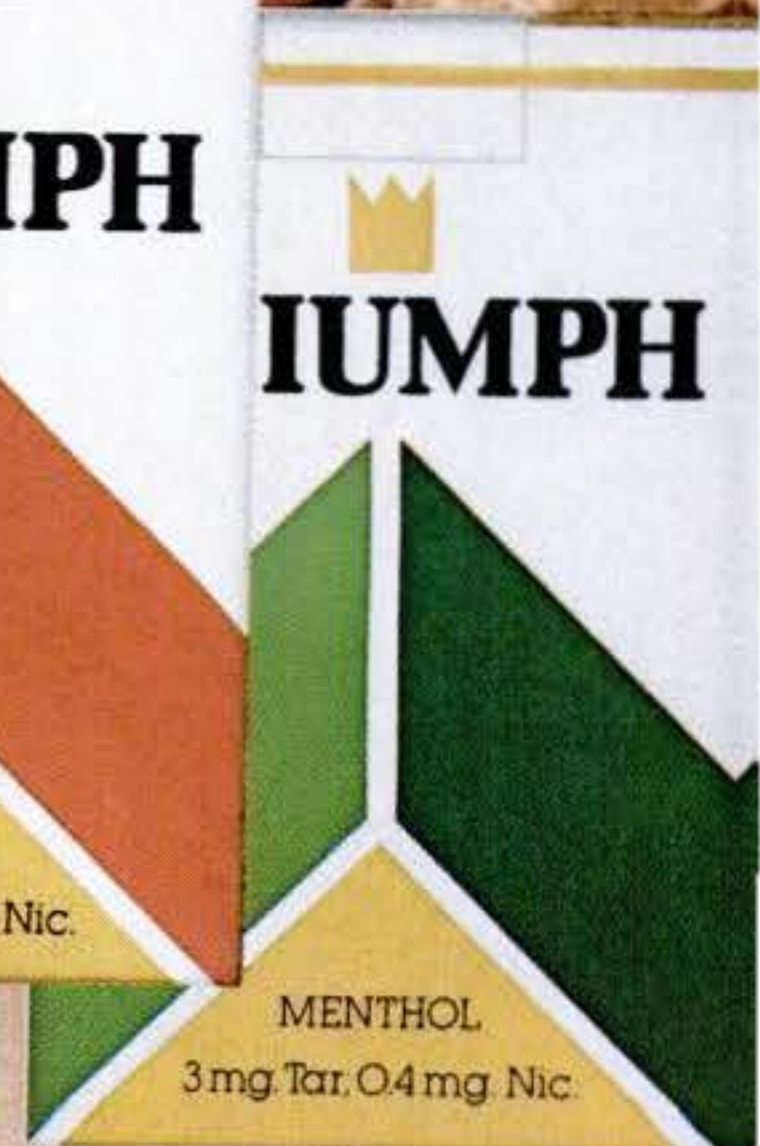
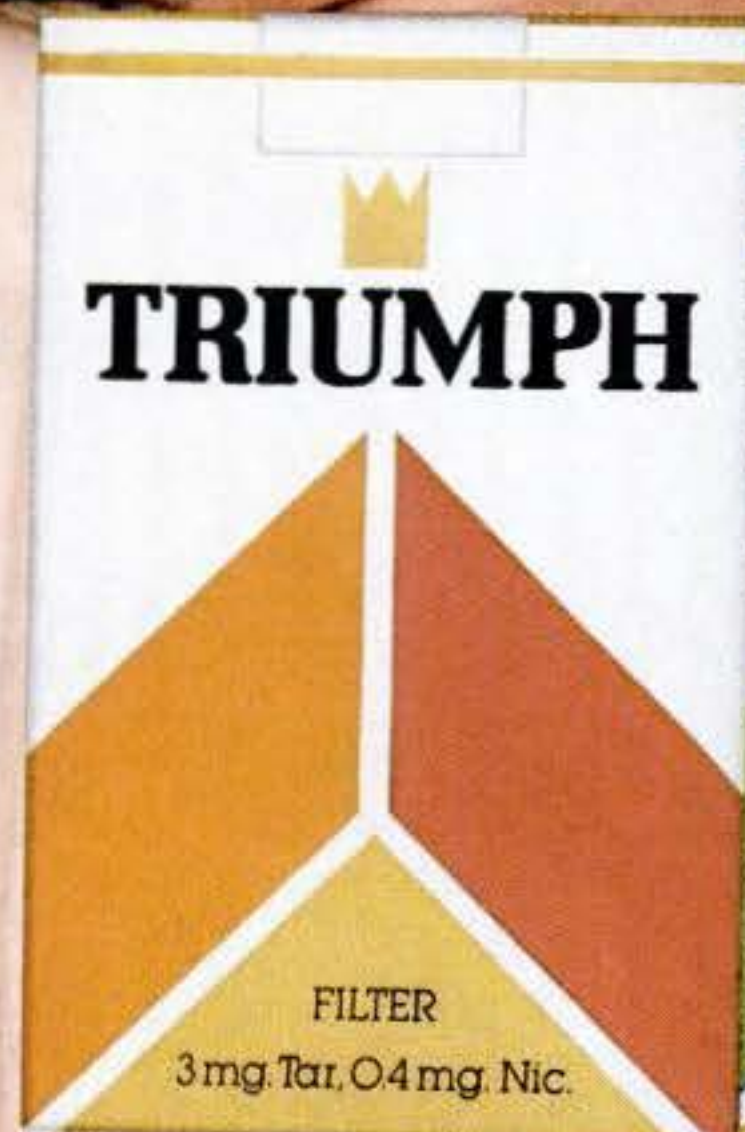




UMPH!

Taste the Umph! in
TRIUMPH®

only 3mg tar



Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health.

©Lorillard, U.S.A., 1980

Filter: 3 mg. "tar," 0.4 mg. nicotine av. per cigarette, FTC Report Jan. 1980.
Menthol: 3 mg. "tar," 0.4 mg. nicotine av. per cigarette by FTC Method.

YOU DON'T GET TO BE THE BEST SELLING IMPORT IN MAINE, VERMONT AND ALASKA ON LOOKS ALONE.

It isn't just the mountains that are rugged in Maine. The driving conditions and the price of gas are no picnic either.

The same goes for Vermont. And certainly for Alaska.

That's why it's very, very interesting that in all three states the #1 imported car is Subaru.

Why? Our cars are dependable. Easy on gas. And easy to handle.

We make a full line of front wheel drive and *On Demand* 4-wheel drive vehicles that can handle almost anything.

And on top of being very affordable, they've earned a reputation for durability and reliability. Great to have no matter where you live.

In fact, even if you only see snow on television, wouldn't it be great to have a car that's over-qualified?



SUBARU
INEXPENSIVE. AND BUILT
TO STAY THAT WAY.



4WD WAGON

1981 EPA ESTIMATES FOR OUR 4WD WAGON. USE ESTIMATED MPG FOR COMPARISONS. YOUR MILEAGE MAY DIFFER DEPENDING ON DRIVING SPEED, WEATHER CONDITIONS AND TRIP LENGTH. ACTUAL HIGHWAY MILEAGE WILL PROBABLY BE LESS.

©SUBARU OF AMERICA, INC. 1980.

HIGHLIGHTS OF THIS ISSUE

Solving the mystery of the sun's violent flares

Satellite observation of 2,000 sunspot events yields unprecedented data. PAGE 66

Flat-screen TV—almost here?

Pocket-size models should be available next year, wall-hung models later. PAGE 54

Detroit preview—fuel-efficient designs for '82 and '83

Innovations from the Big Four may whet the public's domestic-car appetite. PAGE 84

Solar Challenger

MacCready's latest aircraft climbs 3,800 ft. on 100-percent sun power. PAGE 60

Compact cargo carriers for today's smaller cars

Little luggage space in your high-mpg car? See these new carriers. PAGE 70

COVER PAINTING BY RAY PIOCH

CARS AND DRIVING

PS car test: mid-size coupes —plusher, trimmer, lighter	44
Compact cargo carriers for today's smaller cars	70
Detroit preview—fuel-efficient designs for '82 and '83.	84
Cooling-system service for today's hotter-running engines. . .	104

ENERGY NEWS

Ferro-cement collectors for space heating.	14
Tubes and tanks for solar heat . . .	116

NEW PRODUCTS AND INVENTIONS

Soft furniture	11
Twin-engine ultralight	12
Bat with a bend.	29
Digital multimeter	30
Flat wiring is 0.035 in. thick	43
Garbage cruncher	65
Clever contraptions from the Geneva International Exhibition . .	87

NEW TECHNOLOGY

Magnetic furnace cooks the danger out of hazardous waste . .	64
---	----

SPACE AND AVIATION

Y-tailing into the 21st century: advanced-design Lear Fan 2100 . .	57
Solar Challenger flies on sun power alone	60
Satellite report: solving the mystery of the sun's flares.	66

ELECTRONICS

Flat-screen TV —almost here?	54
The computer revolution in shortwave receivers.	74

TOOLS AND TECHNIQUES

Air tools put pro muscle in your shop	100
Battery-powered log splitter. . . .	126

What's New DIGEST

Bike locker	76
Super chopper	77
Pillbox	78
What's new in boating.	79
What's new in tools.	80
What's new in home improvement	81
What's new in electronics	82
What's new for your car.	83

HOME AND YARD

Wood paneling goes up with a clip	90
PS leisure-home plan: earth-sheltered two-story	94
Patch up your driveway	96
4-in-1 backyard center	98
Butcher-block construction.	127
Replace your porch columns	144

OUTDOOR RECREATION

New-wave wind surfers: buyers' guidelines	92
--	----

REGULAR FEATURES

PS readers talk back	6
Through the viewfinder	21
Motorcycling.	22
"Say, Smokey—"	24
Detroit report	32
Science newsfront.	39
PS/What's news	53
Taking care of your car	110
Housepower clinic.	113
Wordless workshop.	114
Shop talk	118
Product information.	143

EDITORIAL OFFICES 380 Madison Avenue, New York, N.Y. 10017

Published monthly by TIMES MIRROR MAGAZINES, INC., 380 Madison Avenue, New York, N.Y. 10017

SUBSCRIPTION SERVICE. (Only mail regarding subscriptions should be sent to Boulder, Colo., address below.) *New or renewal orders:* Send to Popular Science Subscription Department, Boulder, Colo. 80302. In U.S. and its possessions, one year \$11.94, two years \$22, three years \$30; in Canada and elsewhere, one year \$15.94, two years \$28, three years \$42. Single copy \$1.50. *Subscription orders processed electronically.* For all *subscription adjustments*, write to Robert Harlan, Popular Science, P.O. Box 2871, Boulder, Colo. 80302. For change of address allow eight weeks; please give both old and new addresses. *Postmaster:* Please send notices of undelivered copies (Form 3579) to Mr. Harlan. Controlled-circulation post-

age paid at New York, N.Y., and additional mailing offices, publication number 493730. Popular Science is entered as second-class matter at the P.O. Dept., Canada. Microfilm editions are available from University Microfilms, Ann Arbor, Mich. 48106. **ADVERTISING OFFICES.** New York: 380 Madison Ave. (10017), Tel. 212-687-3000; Chicago: 875 N. Michigan Ave. (60611), Tel. 312-337-7717; Detroit: 19075 W. 10 Mile Rd., Southfield, Mich. (48075), Tel. 313-352-8333; Los Angeles (Pacific West Coast): 3550 Wilshire Blvd., Suite 908 (90005), Tel. 213-380-1936. *Mechanics and Handicraft* © Popular Science © Copyright © 1981 by Times Mirror Magazines, Inc. All rights reserved. Printed in U.S.A.

A comparison of projections from manufacturers' treadwear ratings under the new government Uniform Tire Quality Grading System indicates that on a government-specified course:

Michelin fell a little short of the Uniroyal Steeler. About 24,000 miles short.

For many people, Michelin has always been the yardstick to compare other tires by.

But recently, the U.S. Department of Transportation gave the public a standardized system. Now, each tire company is required by law to grade its tires in three areas. Traction. Temperature resistance. And treadwear.

And then to emboss the resulting grades on the sides of the tires.

When compared, Michelin's XWW rated somewhat better than Uniroyal's comparable Steeler in the traction and temperature resistance tests.

But when it came to the important grade that indicates the relative wear rate of your tire, Michelin's tire fell a little short. In fact, when you translate their ratings into projected miles on the government-specified test course, you see it was no photo finish.

On that course, the mileage projection for Uniroyal's Steeler is 66,000 miles. 24,000 miles longer than Michelin's rating projects.

(And, by the way, 15,000 miles longer than the projections from the ratings of the Goodyear, Goodrich, General and most Firestone tires in the chart.)

These mileage projections (including those in the chart) should be used for comparison only. You will probably not achieve these results. Actual treadlife will vary substantially due to your driving habits, condition of vehicle and, in many sections of the country, road conditions and climate.

See your Uniroyal dealer for details.

UNIROYAL

You'll see there may be a new yardstick to compare tires by.

Uniroyal.

Clip and take this to your Uniroyal dealer:

MANUFACTURERS' RATINGS FOR U.S. GOVERNMENT QUALITY GRADING SYSTEM			PROJECTION OF MILEAGE ON GOVERNMENT- SPECIFIED TEST COURSE
Manufacturer/Tire:	Traction and Temperature Resistance	Treadwear	
UNIROYAL Steeler	B/C	220	66,000
GOODYEAR Custom Polysteel	B/C	170	51,000
FIRESTONE 721 (13" & 14" sizes)	B/C	170*	51,000
GENERAL Dual Steel II	B/C	170	51,000
B.F. GOODRICH Life Saver XLM	B/C	170	51,000
MICHELIN XWW	A/B	140	42,000

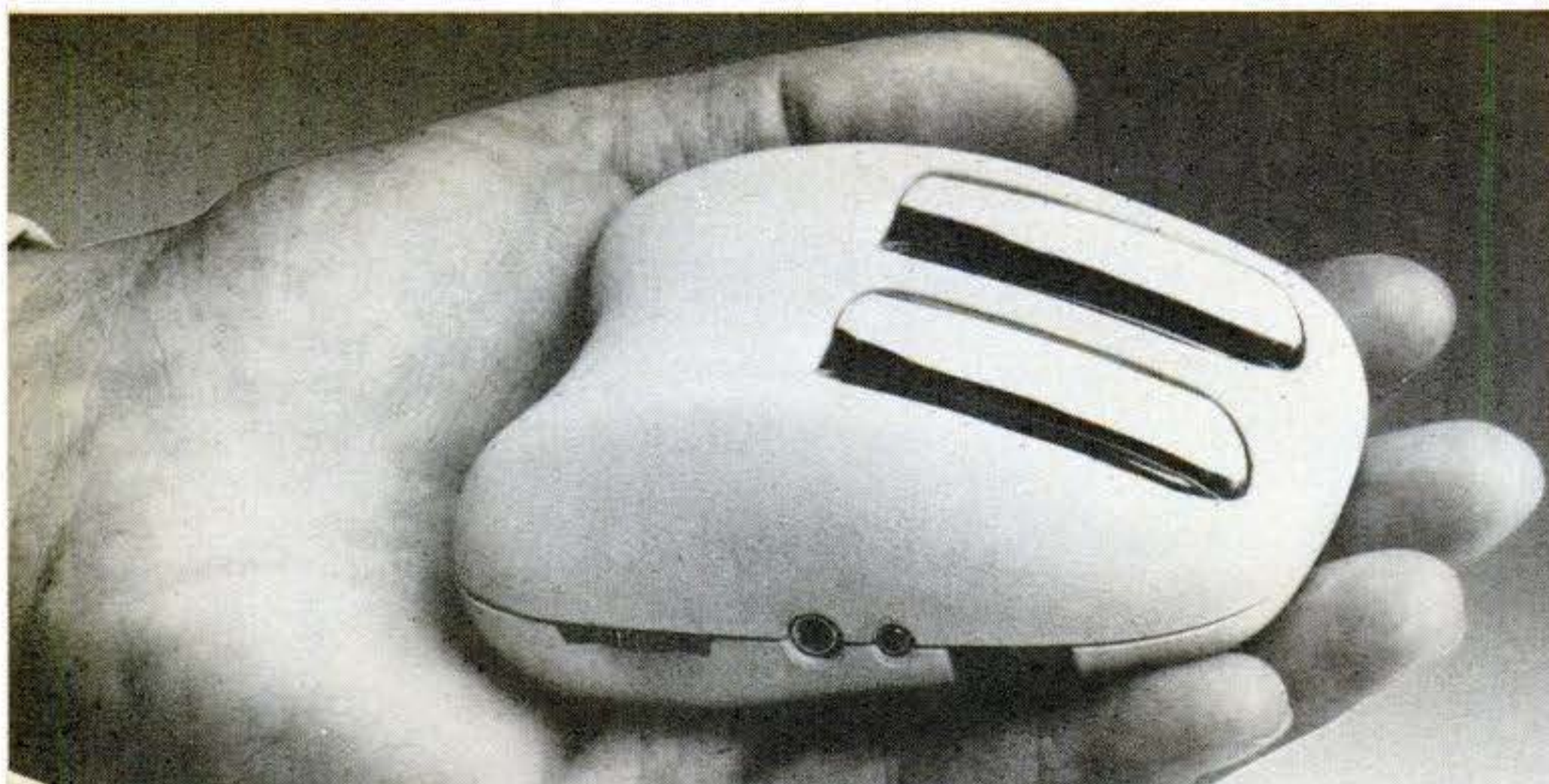
*Most 15" Firestone 721 tires rated 200 which projects to 60,000 miles.

Source: U.S. D.O.T. 12/19/80.

For a free booklet on grade-labeling, please send your name and address to:
Uniroyal, Inc., Tire Advertising Department, Middlebury, Connecticut 06749.
© 1981 Uniroyal, Inc.



**When you compare,
you want Uniroyal there.**



STRESS CONTROL IN THE PALM OF YOUR HAND.

Stress is a very real part of life. And it can't be avoided (not even on a desert island). However, with a little help, you can control the way your body reacts to stress—for achieving greater relaxation, more efficiency, and very possibly, a longer life.

Introducing the latest refinement in stress control technology: the GSR 2. Compressed into its case (no bigger than a bar of soap) are the benefits of a laboratory full of sophisticated and expensive biofeedback equipment. And amazingly, for just \$49.

Relax under pressure.

You start by placing your fingers on the GSR 2's stainless steel sensing plates. Automatically GSR 2 turns itself on, and produces a pleasant humming tone which raises or lowers, depending on your level of tension. Hear it lower when you imagine yourself napping on a warm sandy beach. Listen to it rise when you think about interest rates! Then let the doctor-prepared cassette tape (or the written instructions) take you step by step through the simple relaxation process—continuously monitored by the GSR 2. The deep relaxation you experience in your short daily sessions automatically transfers into your everyday life. *The improved ability to relax under pressure actually becomes a part of you—forever.*

GSR 2 biofeedback works through galvanic skin resistance, a highly accurate and medically accepted method of measuring overall mind/body tension. (A comparison test against a \$5000 laboratory unit found the GSR 2 just as accurate.)

Immediate rewards.

Right away, the stress-sensitive audio tone rewards you with a concrete measure of progress. Unlike all other relaxation methods, there's no guesswork involved. Results are quicker, and deeper.

As you relax, you begin to possess a soothing, almost sensual feeling of total rest. Conscious relaxation can be even more efficient than deep sleep. Every muscle, every fiber of your body will seem totally drained of tension. At the same time you're fully in touch with your surroundings.

Tranquilizers and alcohol can relax you too. But they only mask symptoms and impair performance. The GSR 2

breaks the stress cycle naturally, leaving you refreshed and energetic.

A competitive edge.

Designed by a team of Canadian doctors and engineers, the GSR 2 is used in over 1000 medical and educational institutes worldwide for prevention and treatment of a variety of stress related ailments.

In industry, the GSR 2 is particularly useful in view of deadline pressures and work overloads. Stress reduction means increased personal productivity.

It also helps perfectly healthy athletes perform better. GSR-trained champions include a famous American marathoner, the U.S. Olympic Nordic Ski Team, and a host of professional football and hockey players.

Our stress-free offer.

We invite you to use the GSR 2 for 30 days without obligation. If you decide not to keep it, The Sharper Image will send a prompt refund, including delivery charge.

The 4 ounce GSR 2 (3" x 4" x 1½") is virtually unbreakable, all solid state electronics. Comes with earphone, instructions, cassette tape, two-year 9 volt battery in place, and one year warranty. Turns off automatically so you can use it to relax yourself to sleep.

Gain a powerful control over stress with this fascinating new tool of micro-computer science.

30-DAY HOME TRIAL.

Order product #189. Credit card holders may use our toll-free number. Or send check for \$49 plus \$2.50 delivery (in CA, add \$2.94 sales tax). Please mention this magazine.

800 227-3436

In California 800 622-0733

THE SHARPER IMAGE™

260 California St., San Francisco, CA 94111
(415) 788-8880 ©1981 The Sharper Image

**Popular
Science**

Editor-in-Chief C. P. Gilmore
Editor Everett H. Ortnor
Executive Editor Herbert Shuldiner
Art Director W. David Houser
Copy Chief David D. Vigren

GROUP EDITORS

Arthur Fisher
Science & Engineering/Special Projects
Richard L. Stepler *Consumer Information*
Alfred W. Lees *Reader Activities*

SENIOR EDITORS

Jim Dunne *Automotive*
John Free *Technology*
William J. Hawkins *Electronics*
E. F. Lindsley *Engineering*

ASSOCIATE EDITORS

Paul Bolon, Ray Hill, Edwin C. Jacobs (*Automotive*),
Susan Renner-Smith, Daniel J. Ruby, V. Elaine Smay

Copy Editor: Timothy O. Bakke

Assistant Copy Editor: Kathleen Murphy Lord

Photographer-Picture Editor: John Keating

Home & Shop Editor: Alfred W. Lees

Boating Editor: David D. Vigren

Art Editors: John F. Crowley, Richard J. Meyer

Art Associate: Hugo Salhuana

West Coast Editor: Jim Schefter

Southeast Editor: Evan Powell

European Editor: David Scott

Editorial Assistants: Kathleen Brown (Chief),
Marita Begley, Eleanor Freebern, C. Daniel King,
Gary W. Morgan

Senior Production Manager: Henry W. Kazmirowski

Business Manager: Anna Dallas

ADDRESS EDITORIAL MAIL to
Popular Science Editorial Dept.
380 Madison Ave., New York, N.Y. 10017

We cannot be responsible for loss of unsolicited queries, manuscripts, or photos. They will not be returned unless accompanied by return postage. We welcome readers' comments, but regret that the volume of mail does not permit us to answer each letter individually.

CONSULTING EDITORS

Jim Schefter, *Space*
Edwin A. Link, *Oceans*
Jan P. Norbye, *Automobiles*
A. J. Hand, *Photography*
Smokey Yunick, *Auto Mechanics*
Robert Gannon, *Science*
Phil McCafferty, *Projects*
R. J. De Cristoforo, *Tools & Techniques*
Richard Day, *Home & Shop*
Ben Kocivar, *Flying*
Paul Wahl, *Guns*

F. X. WILKINSON *Vice-President, Publisher*
TERENCE E. MOYES *Advertising Director*

Published monthly by
TIMES MIRROR MAGAZINES, INC.,
380 Madison Avenue, New York, N.Y. 10017
A Times Mirror Company

ISSN 0161-7370

MATTHEW T. BIRMINGHAM JR.
Chairman of the Board

JOHN A. SCOTT *President*

GORDON B. HALL JR. *Senior V.P.*

STUART BERNARD *Senior V.P.*

HUBERT P. LUCKETT

Vice-President/Editorial Director

GERTRUD BORCHARDT *Production Director*

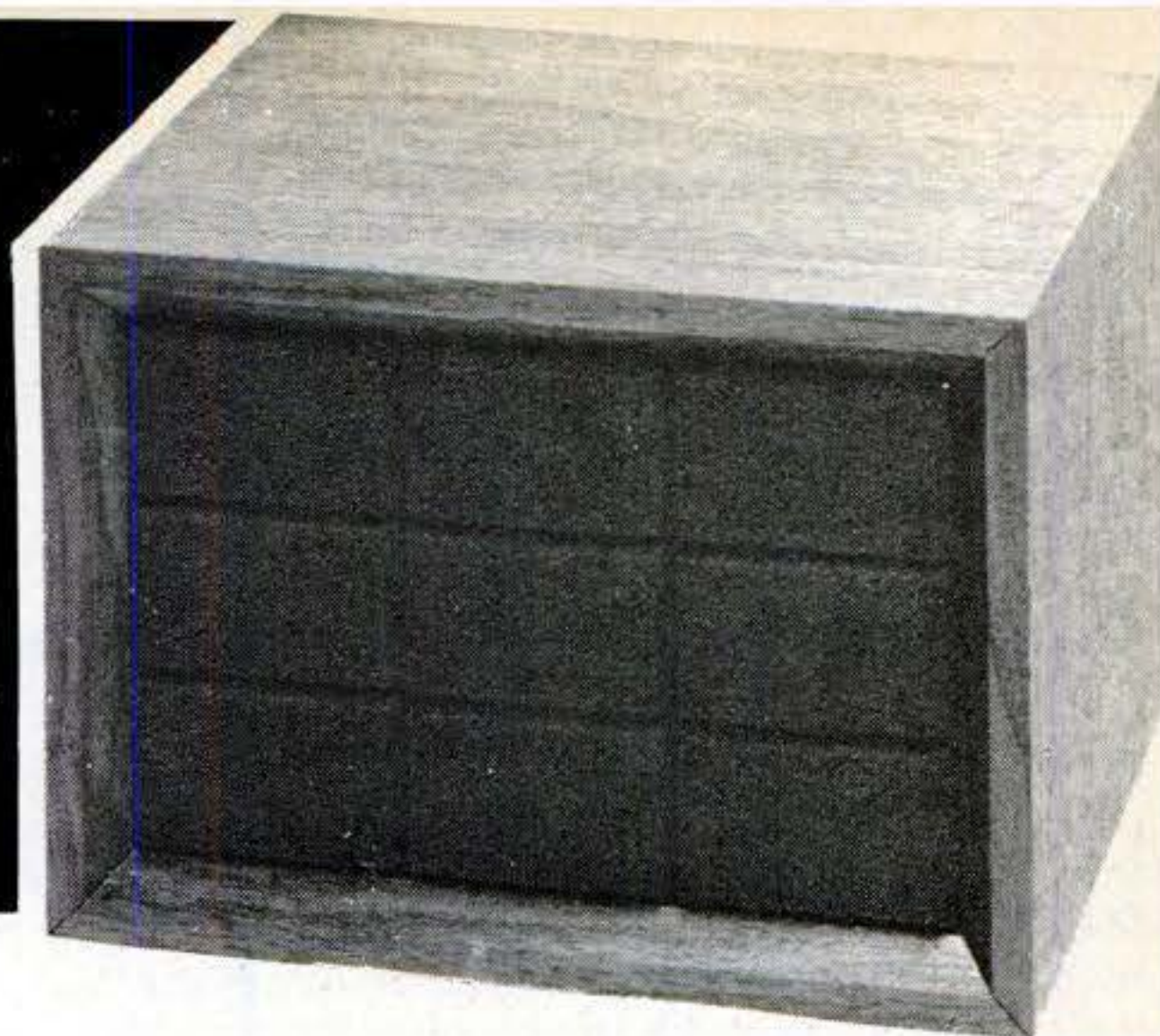
JOHN FRY *Publications Development*

WARREN H. BRAREN *Circulation Director*

THOMAS J. GARRISON *Treasurer*

Don't Leave Your Home UNPROTECTED guardex™

**Protects Every Square Inch Of Your Building
Turns On Lights Automatically
Powerful Electronic Siren**



The Guardex 8000 Alarm System is walnut grained and disguised to look like a small stereo speaker (6 3/4" x 9 3/4" x 8") and weighs less than 6 1/2 pounds.

EXIT AND ENTRY DELAY

The Guardex 8000 alarm has a built-in exit delay allowing you approximately one minute to lock up and leave the building before the alarm is armed. When you enter your building you may find that just your normal entering sounds activate the siren. You may delay it from starting for up to 30 seconds by turning up the siren entry delay control.

BATTERY BACK-UP

Burglars rarely cut power. However, to give you total protection from a burglar and possible power failure, our alarm has provisions for a battery back-up. (Batteries not included). 12 volt lantern batteries are available at most hardware stores.

THE BURGLARY PROBLEM

The F.B.I. statistics show that at the present rate, one out of every four Americans are going to be burglarized. That is not a very pleasant fact, but it is true. You have a greater chance of being burglarized than being a victim of a fire or automobile accident. The time is now to help protect yourself and your valuables with a Guardex 8000 alarm system.

WARRANTY

One year, 100% parts and labor when returned to factory post-paid. A five year extended warranty is available for a charge of \$25.00.

OUTSIDE SIREN

The Guardex 8000 alarm is equipped with a loud, built-in siren, but if you desire an additional siren to mount outside or in an area away from main alarm, they are available with 50 feet of wire for \$29.95. (Connecting terminals are provided on the back of the alarm).

30 DAY NO RISK TRIAL

This is your opportunity to purchase an alarm system directly from the factory for only **\$239.95**. Try it in your home or business for thirty days without risking one cent. Put our Guardex 8000 alarm to your own test. See for yourself! It will protect every window and door from break-in. If you are not completely satisfied, return the alarm within 30 days of receipt for a complete refund. To order your Guardex 8000 alarm, **CALL TOLL FREE** to charge your credit card or send your check to Guardian Electronics, Inc. in the amount of **\$239.95** plus \$4.95 postage, handling and insurance. If you want the optional outside siren, add \$29.95. Optional outdoor 7" x 10" metal warning sign (stake not included) add \$9.95. (California residents add 6% sales tax.)

(If you require more information, call during California business hours, Monday - Friday).

Dealer Inquiries Invited

CALL TOLL FREE
(800) 423-5499

**GUARDIAN
ELECTRONICS**
31117 Via Colinas, Dept



California residents:
(213) 889-1414 collect.

This One



2KCF-J4G-RY7U

Copyrighted material

Low Cost Computerized Burglar Alarm System Home - Office - Business

NO INSTALLATION

Just plug the Guardex 8000 alarm system in, make two simple control adjustments to suit your particular building and it works! There are no other wires to run. This totally self-contained burglar alarm can completely seal off every square inch of the surface of your building. It protects doors, windows, and what most alarms miss... your roof, walls and floors.

HOW CAN ONE SMALL COMPUTER PROTECT MY WHOLE BUILDING?

Guardex 8000 Alarm System works on the principle of audio discrimination. This, put simply, is the process of electronically separating normal everyday sounds, such as voices, telephones, etc. from break-in type noises such as breaking glass, crying metal, or forcing a door open. The Guardex 8000 protects one story homes and offices up to 2000 square feet and open commercial buildings up to 10,000 square feet. The Guardex 9300 with wireless remote sensor capability is available for multi-story homes and offices or single story with more than 2000 square feet. Call the factory for more detailed information.

TURNS ON LIGHTS AUTOMATICALLY

When the first break-in type sound is detected, the system will instantly turn on lights, radio, or other electronic equipment that you have plugged into the back of the alarm. These lights or other equipment will remain on for a period of five minutes, then automatically turn off.

POWERFUL ELECTRONIC SIREN

The Guardex 8000 alarm is equipped with a loud built-in siren. If during the five minute period the lights or other electronic equipment has been activated, a second break-in sound is detected, (it can be only a second or two after the first break-in sound) the built-in siren will start blasting for 90 seconds. At the end of approximately 90 seconds the siren will shut off and the alarm listens again. If another break-in sound is heard, the siren will come on for another 90 seconds. If no other break-in sound is detected, the siren will stay off and at the end of the five minute period the lights will shut off and the alarm instantly resets.



The rear control panel contains two standard AC plug receptacles for a table lamp, spot lights, radio, etc., terminals for connecting optional outside siren and back-up battery (battery not included); entry delay time control and sensitivity control.

PS READERS TALK BACK

Address letters for this column to: Readers Talk Back, Popular Science, 380 Madison Ave., New York, N.Y. 10017. Because of the large volume of mail, we are unable to acknowledge unpublished letters.

V/STOL rings a bell

I was fascinated by your cover article on the "Tilt-Engine V/STOL" plane [PS, March]. A flying demonstrator could be built for \$100 million? About 25 years ago, Bell Aircraft designed a similar plane but couldn't arouse much Air Force interest, so it was built for less than \$100,000 using corporate research funds. The structure was a Schweizer glider fuselage and tail, a Cessna wing, and Bell Helicopter landing gear. The Air Force did supply two small jet engines and an air compressor to provide control air jets at the wing tips and tail. The engines, mounted on a tubular shaft through the fuselage, were controlled with twin Evinrude throttle controls. Flight-control feasibility was checked out with a wooden mock-up of the stick and rudder linked to a simple analog computer that fed in aircraft inertial and engine gyroscopic moments. I was one of the pilots who "flew" the mock-up to determine if we could control it. We could, and test flights proceeded. The "fountain effect" close to the ground was anticipated, so the flights were made from a steel grating mounted about eight feet above the ground.

John F. Strickler Jr.
Camano Island, Wash.

Build it round

Solar houses that have been illustrated in Popular Science have generally been of a square or rectangular shape. But applying the discussion of the relative merits of round versus square postal packages ["Calcu-letter," PS, March] to house design leads to some intriguing questions: If a cylindrical package gives more volume per surface area than a cubic one, wouldn't a cylindrical house have an advantage over a conventionally shaped one by minimizing the exterior walls exposed to weather? Wouldn't a round house also slough the wind better? I'm sure my grandfather had some very good reasons for building a square house, but I wonder if those reasons still apply.

Dan Davis, Eugene, Ore.

Darrell Huff, "Calcu-letter" columnist and experienced house builder, replies: "In terms of energy efficiency, a square house is better than a rectangular one, a cylindrical house is better yet, and a spherical one is best of all. The problems are that construction costs may be higher for round walls and that many people regard rectangular interior rooms as the most useful arrangement. The latter point is a matter of taste, though. And there are many clever ways around the cost problem. You can approach a rounded shape by building six or eight straight walls instead of four. Spherical domes are common; some cost less than conventional homes."

Ionizer cure-alls

Yes, the operation of ionizers for air cleaning can be substantiated, but introduction of excess ions into air can't ["Shop Talk," Feb.]. I presented a scientific paper on the subject in August 1979 (XII International Conference on Medical and Biological Engineering). As of that date, there was no evidence to back up negative-ion generators as effective contributors to ion excess in air. As a corollary, the biological effects must remain an open question until the physical facts can be established.

William Paul
Univ. of Toronto, Toronto, Ont.

Hatchback comebacks

Jim Dunne and Ed Jacobs should check their facts more closely ["U.S. Compacts," PS, March]. If General Motors is "still the only builder of four-door hatchback compacts in America," then someone should notify all the owners of Omni and Horizon four-door hatchbacks that their cars are collector items.

Linnaeus Hoopes Jr., Wilmington, Del.

I believe that Pennsylvania is still a part of the U.S. and that New Stanton, Pa., is the home of the Volkswagen Rabbit, which can be bought as a four-door hatchback.

Walter Hendricks, Bensalem, Pa.

Ed Jacobs replies: "The Dodge Omni, Plymouth Horizon, and Volkswagen Rab-

bit are certainly available in four-door hatchback versions, but they are subcompacts. Chevrolet Citation and Pontiac Phoenix are the only compacts with that body style built in the U.S."

Future sails

Your article about modern sail developments for cargo vessels [PS, Dec. '80] was of intense interest to me, a constant advocate and forecaster for three decades of the return to sail (see my book *Adrift*, MacMillan, 1980). The question of safety is paramount. I believe that the safest sailing rig is one that disappears when the weather is beyond its strength. The only way to truly beat a heavy blow is not to resist it. Imagine a lady's fan vertical and open. Now imagine it vertical and closed. Now imagine it being lowered to a horizontal position. There is my vision of the sails of the next century. Feluccas and Malayan proas can still teach us a thing or two.

Tristan Jones, New York, N.Y.

Mislocated launch

The item in your March "Science News-front" about a new communications satellite contains a widely prevalent error. The INTELSAT was not launched from Kennedy Space Center, but from the Cape Canaveral Air Force Station—some distance east and across the Banana River. Only manned launches are made from KSC.

C. J. Marshall, Cape Canaveral AFS, Fla.

Dialing for time

The article "Updated Sundial" [PS, Feb.] raised my eyebrows a bit. The cylindrical dial described is in no sense new, nor is it particularly accurate in comparison with existing forms. Cylindrical sundials, first developed for portability, date back hundreds of years. Furthermore, statements such as "the sundial became obsolete with the development of standardized time" and "this 20th century sundial has finally made sundials accurate" reflect a hazy knowledge of astronomy and solar instruments. Standard (not "standardized") time did not render dials obsolete, since corrections for this could readily be incorporated. Nor can the cylindrical dial illustrated claim to be accurate in terms of clock time when interpolation in two axes is required.

G. R. Johnson, Islington, Ont.

Correction: A caption in the March car test incorrectly identified the car being filmed by an NBC film crew. It is a Dodge Aries K, not a Chevrolet Citation as stated.

POPULAR SCIENCE READER SERVICE Check below to report a change of address. Or to get more mail. Or less mail.

Name		
Address		
City	State	Zip Code
It helps if you attach your address label (or copy your name and address exactly as they appear on your label) in the space above.		

- ☐ MOVING NOTICE. Put your old address at left, your new one at right (Please give us six weeks' notice.)
- ☐ UNLISTING SERVICE. Check here if you don't want to receive mail from advertisers who use the POPULAR SCIENCE list. (Be sure to attach your label at left.)
- ☐ LISTING SERVICE. Check here if you're not a subscriber but want to receive mail from advertisers who use the POPULAR SCIENCE list. (Be sure to fill in your name and address at right.)

Name		
Address		
City	State	Zip Code
POPULAR SCIENCE, P.O. Box 2871, Boulder, Colo. 80302.		



THE NEWEST.

A watch that fires missiles? If you think that's extraordinary, read on. Discover four gifted machines that were, until recently, technological visions. Now they're real, and dramatically priced.

Best of all, one toll-free phone call brings any or all of these geniuses into your home—where you'll have a full 30 days to get a closer look. And a full refund (including delivery charge), if you decide to return it. You're completely protected by the nationally recognized Sharper Image guarantee of satisfaction.

1. Become an instant musician, no experience needed.

Create your own music with new Casio VL-Tone. You combine the sound, rhythms and tempo and VL-Tone plays it back—beautifully.

You can move to a level of musical ability you never thought possible. 5 instrument sounds and 11 rhythm sections let you create your own melodies, put together exciting arrangements, play



With the palm-sized VL-Tone, even a beginner can instantly create—and playback—professional, big sounding music.

compositions that normally take years of musical training. The secret is LSI technology adapted to recreation of sounds and rhythms in electronic form. The VL-Tone is a revelation. Play anything. Play it back. Speed it up. Slow it down. Memorize it. Add a rhythm. There's always something new.

Uses 4 AA batteries. Can take ear-phones. Also plugs into home stereo for larger sound. Full function memory calculator, year warranty, case, full instructions. Now, you'll own the most amazing musical instrument in the world. 1" x 11 3/4" x 3". Casio VL-Tone #395 \$69.95 (3.50) AC adapter AD-1U #397 \$7.25 (.75) VL-Tone Song Book #403 \$5.00 (.75)

2. Top-rated pocket stereo. Unbelievable price.

The new \$99 Technidyne is the first portable cassette stereo to equal or surpass the performance specifications of the \$200 Sony Walkman™. Extended frequency range produces incomparable fidelity, truer sound. Stronger, more reliable motor drive minimizes wow and flutter (distortion)—even during active sports.

Comes with shoulder strap, demonstration tape, and ultra-light (2 1/4 oz.) collapsible headphones—a Technidyne exclusive. Optional nylon waist pack provides added protection for sailing, hiking, etc. Add a second set of headphones for tandem listening. Built-in Talk button allows conversation or singalong. Tone and slide-volume controls for each channel. 3 1/2" x 5 1/4" x 1 1/2" unit takes 4 AA batteries. 90 day warranty.

Now you won't leave your best listening at home. Nothing sounds—or performs—better than the Technidyne.

Technidyne Stereo #400 \$99 (2.50)
Sport Waist Pack #401 \$19.95 (1.50)
Additional Headset #402 \$19.95 (1.50)

3. Cordless telephone breakthrough.

Most advanced—and beautiful—cordless telephone ever—the new Muraphone 600. Extended 700 foot range takes your phone almost anywhere—even to the neighbors.

Small hideaway base station plugs into your phone jack; then forget it. The remote handset recharges weekly at any wall outlet—a Mura exclusive.

Excellent fidelity, works just like a normal extension phone. Dial out, receive calls, even automatic one-button redial.

FCC approved, comes with 90 day warranty, full instructions, base and remote, everything needed for the luxury of cordless telephoning. Now put your phone where you are: basement, yard, office, or bath.

Muraphone 600 #399 \$199 (3.50)

4. Amusement park on your wrist.

Casio just put an exciting game—and much more—into their best-selling calculator watch. "Counterattack" tests your reflexes as you destroy enemy missiles, increasing skill level as you play. Hear each shot fired—scoreboard tallies your hits. Complete battlefield action right on your wrist.

Eight digit calculator is easily worked even by large fingers. Two line display shows day, date, time. Features 24 hour repeating alarm, hourly chime, 12/24 time-keeping in two time zones, stopwatch to 23:59:99. Black resin case and band, glass crystal. Instructions, battery and year warranty included. This genius conquers time, finance—and boredom.

CA-90 Calculator Game Watch #396 \$49.95 (2.50)

30-DAY HOME TRIAL.

Credit card holders may use our toll-free numbers below. Or send check, including delivery charge (shown in parentheses at end of product descriptions). Add 6% sales tax in CA.

Please mention the 3-digit product number and this magazine.

800 227-3436

In California 800 622-0733

THE SHARPER IMAGE™

260 California St., San Francisco, CA 94111
(415) 788-8880 ©1981 The Sharper Image

A man in a cowboy hat and vest, holding a lasso, with a cigarette in his mouth. The background is a warm, golden-brown color.

Come to Marlboro

17 mg "tar," 1.1 mg nicotine av. per cigarette, FTC Report Dec '79

Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health.

Country.



Marlboro Red or Longhorn 100's—
you get a lot to like.

LONG DISTANCE HAULER. NEW DATSUN DIESEL



WHAT'S THE LONGEST DISTANCE BETWEEN TWO PUMPS? FOR DATSUN PICKUPS, IT'S OVER 550 MILES.*

Introducing the new Datsun diesel. It has the power and mileage you'd expect in a diesel, and in the Long Bed more range than any Datsun ever: 557* miles on a tankful, from an engine with over 3 billion miles of experience behind it. Datsun and diesel: a tough combination.

A TRUE TRUCK.

This rugged rig is a half-ton of tough, suspended in front on ride-smoothing independent front torsion bars. It hauls a full 1,400-pound payload of cargo and passengers on a ladder-type chassis. Just like a semi.

THREE TOUGH CHOICES.

Choose from the Long Bed, exclusive King Cab® or the Li'l Hustler™...biggest choice in compact diesel pickups. Whichever Datsun diesel you pick, you're getting the greatest economy of all: miles per gallon and years per pickup. Just what you'd expect from Nissan Motor Co. Ltd., the worldwide company whose name stands for quality.

Want to go more miles between fill-ups? Go straight to your Datsun truck stop.

557
*MILES
EST.
RANGE

33
EPA EST.
MPG

692
MILES
EST. HWY
RANGE

41
EPA EST.
HWY

Range estimates based on EPA est. mpg and hwy mpg multiplied by 16.9 gal. tank. Use est. mpg for comparison. Your mileage may differ depending on speed, trip length and weather. Hwy mileage and range will probably be lower. Not available in California.



Hang up a closet, relax in a sling with soft furniture



It's portable, compact—and won't put a dent in your budget

By KATHLEEN MURPHY LORD

Your new apartment may be small, but it's ideal for you—in every way but one: It has little storage or shelf space. The time and expense—and precious square footage—it would take to build some just don't excite you. And ever-climbing rents make a larger apartment an unattractive alternative.

With the apartment dweller's predicament in mind, California architect Richard Pathman designed this

unique soft furniture for Up & Co. (190 Hubbell St., San Francisco, Calif. 94107). These canvas shelves, suspended closets, and sling-type chairs were created to be functional, space-saving, and eye catching, as well. You can even take them along when you move on to bigger and better places.

Soft Shelves (center) consist of canvas compartments suspended on a knockdown tubular-steel frame. Folded clothes and linens can be stored in the center compartments. There are pouches for shoes and socks on one side of the frame, a detachable laundry bag on the other. And a curtain slides across the front to hide your clothes—or clutter—from view. The unit sells for \$250.

The Off-the-Wall Closet (center, rear) combines a shelf, a bar for hangers, and wood knobs for "quick hang-ups." It hangs by two screws. \$55.

A canvas canopy suspended over a wood dowel, the Flying Closet hangs from the ceiling by two hooks (right). Height is adjustable, and the canopy snaps on and off. It costs \$68.

More than 30,000 Netchairs (left) have been sold in the U.S., claims Pathman. Designed for indoors or out, the soft cushion suspended in netting hangs from your ceiling or tree. It's durable, lightweight, and weather-proof. Price is \$57.

As for the headgear the folks in the photo are sporting—let's just say that soft furniture befits soft heads. **P 5**



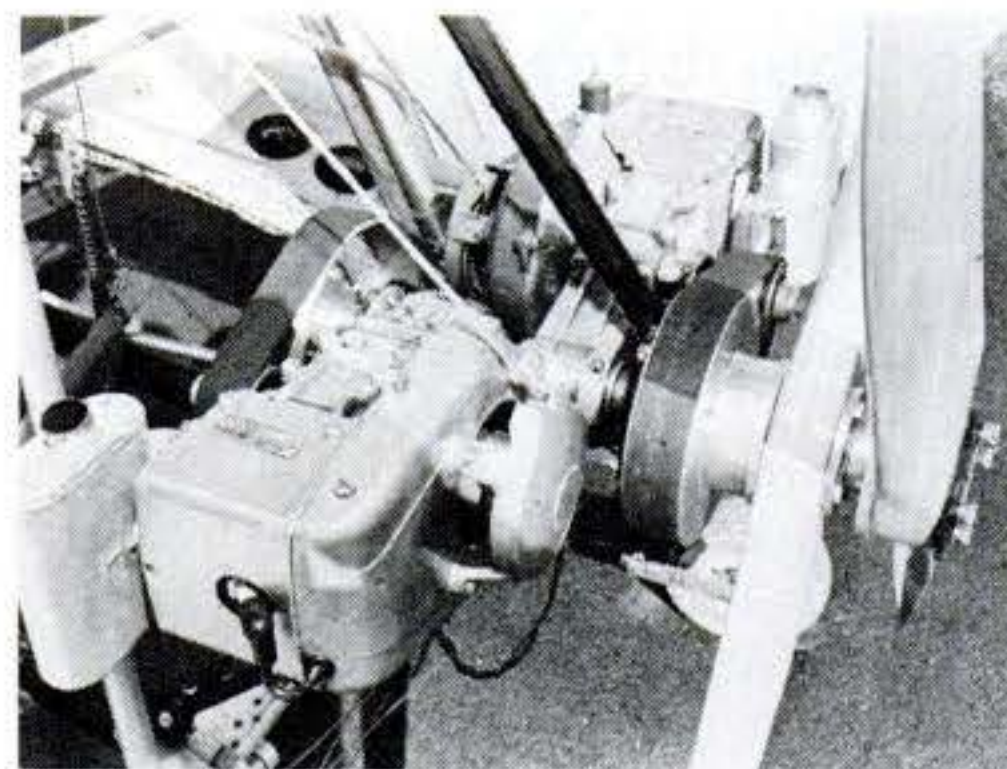
Twin-engine ultralight

Five years ago, John Moody flew into my back yard in his Early Riser, a kit-built Icarus hang glider powered by a small two-stroke engine [PS, Dec. '76]. Frustrated by the lack of hills and by unfavorable weather, he had pioneered the now-popular ultralight-aircraft sport by rigging an engine to his Icarus so that he could take off from level ground and, literally, land on his feet. It worked, but sometimes his takeoffs were heart-stopping.

Three years later, Moody added a three-wheel landing gear to his craft [PS, April '79], which took his feet out of the takeoff-and-landing business.

Now he has made another improvement. Recently he flew in and out of my back yard again. But this time his flying machine had a lot more pep. His takeoff and climb were spectacular, and he'd covered the 50 miles from his home base to my yard in about an hour. The secret: two 10-hp engines instead of one, and two propellers. The propellers rotate in opposite directions off an ingeniously simple and rugged dual-belt drive on a single axis. The plane will take off and climb on a single engine, but the two props, larger and turning slower than the former direct-drive prop, give Moody a quieter, more dependable ride and let him slow the engines to a comfortable rpm for cruising. To prove how well his dual-engine plane performed, Moody had climbed to over 13,000 feet for an ultralight altitude record the day before.

For information on Moody's present ultralights and upcoming closed-cockpit models, send \$5 to Stewart Products Corp., Box 248, Kansasville, Wis. 53139.—E. F. Lindsley



Two engines are opposed, and drive through a belt reduction to central shafts, which turn props in opposite directions. Starter ropes lead to cockpit. Engines can be stopped and restarted in the air.

No Bone Crusher Grip Needed...



... your CHANNELLOCK tongue-'n-groover provides the extra muscle. Long, drop forged steel handles. Patented undercut, can't slip adjustments. Parallel grip jaws. Right angle teeth. A power combo that multiplies your grip, generates tremendous leverage with less effort. Be sure you get the genuine CHANNELLOCK. Look for THAT trademark on the pliers you buy.

CHAN NEL LOCK

CHANNELLOCK, INC. • Meadville, Pennsylvania 16335
Meet The Rest Of The Family. Send For Our Free Catalog.





500 MILES FROM NOWHERE, THEY'LL GIVE YOU A CHILLED BEER. OR A WARM BURGER.

Recognize the ice chests in this picture?

Surprisingly enough, there aren't any. What you see instead are two Koolatrons, an invention that replaces the traditional ice chest—and its many limitations—with a technology even more sophisticated than your home fridge. And far better suited to travel.

What's more, the innocent looking boxes before you are not only refrigerators—they're also food warmers.

Refrigerator from outer space.

Because of space travel's tough demands, scientists had to find something more dependable and less bulky than traditional refrigeration coils and compressors. Their research led them to discover a miraculous solid state component called the thermoelectric module.

This electronic marvel has no moving parts to wear out or break down; it's not affected by tilting, jarring or vibration (things that can cause conventional fridges to fail). No bigger than a matchbook, it actually delivers the cooling power of a 10 lb. block of ice.

And thermoelectric modules are the heart of every Koolatron™.

From satellites to station wagons.

Thermoelectric temperature control has now been proven with over 20 years of use in some of the most rigorous space and laboratory applications. And Koolatron was one of the first to make this magic available to families, fishermen, boaters, campers and hunters—in fact, anyone on the move.

Sophisticated controls also enable the two Koolatron models shown to do something no ordinary refrigerator can

do: keep your food warm (by totally reversing the thermoelectric process with the flick of a switch). Now you can refrigerate home cooked food and beverages while travelling—and eliminate costly ice, spoiled food and expensive restaurant meals. Or in winter, switch to heating and serve yourself hot burgers and casseroles while skiing or ice fishing. Even chill wine for your next party. In less than a year, your Koolatron can easily pay for itself—the convenience is a bonus.

A little energy goes a long way. Koolatron plugs into the cigarette lighter in your car, boat, camper or plane with its detachable 9' cord. With the engine on, it can be operated indefinitely with no battery drain (with the engine off, the low battery indicator on models P10 and P34A alerts you

when it's time to restart your engine).

And just how efficient is a Koolatron? It keeps food hot or cold using less energy than a single car taillight. A thick wall of urethane insulation helps maintain selected temperatures hours after the unit is turned off.

Koolatron also works at home or in the office, and for only pennies a day. The new optional AC adapter lets you plug it into any wall outlet—even in your hotel room.

A lifetime of convenience. For as little as \$139.

All Koolatrons are not created equal. Some, like the \$139 P10, give you both cooling and heating—with economy. Others give you even more room, or more luxury. (For full product description, see diagram above.)

And all are virtually maintenance free. In fact, the only moving part—a

small fan—provides many years of trouble free operation with

normal use. If necessary, you can replace it yourself—with just a screwdriver. And the thermoelectric module should last a lifetime (but just in case, we've got major service centers in New York, Arizona and Canada).

Each unit comes with full instructions, convenient service-by-mail information, and one year warranty. Not to mention a full three weeks to enjoy it at our risk—before making your final decision.

For quickest delivery, call us collect using the number below (please mention dept. number shown in coupon). Or mail the coupon itself, with check, money order, or credit card number.

ORDER COLLECT.
0-705-737-0842

Koolatron Industries Ltd.
56 Harvester Avenue, Batavia, New York 14020
Canada: 230 Bayview Drive, Barrie, Ontario L4N 4Y8

Please send me:

- ☐ Koolatron P10 @ \$139. (\$149. in Canada)
- ☐ Koolatron P34 @ \$179. (\$189. in Canada)
- ☐ Koolatron P34A @ \$199. (\$209. in Canada)
- ☐ 110 volt A.C. adapter @ \$39.95 (same in Canada)

Please add \$9.00 per unit for handling and delivery (adapter shipped free if ordered with unit; \$3.00 delivery by itself). Plus sales tax in N.Y., Ont., and Que.

I understand that I may return any item undamaged within 21 days and receive a full refund if I am not satisfied.

- ☐ Check or money order enclosed for the amount of \$ _____ or charge it to my
- ☐ Visa ☐ Mastercharge ☐ American Express

Acct. # _____

Date Expires _____ ☐ Send brochure only.

Signature _____
(necessary to send merchandise)

NAME _____

ADDRESS _____

CITY _____ STATE _____

ZIP CODE _____ PHONE _____

Koolatron

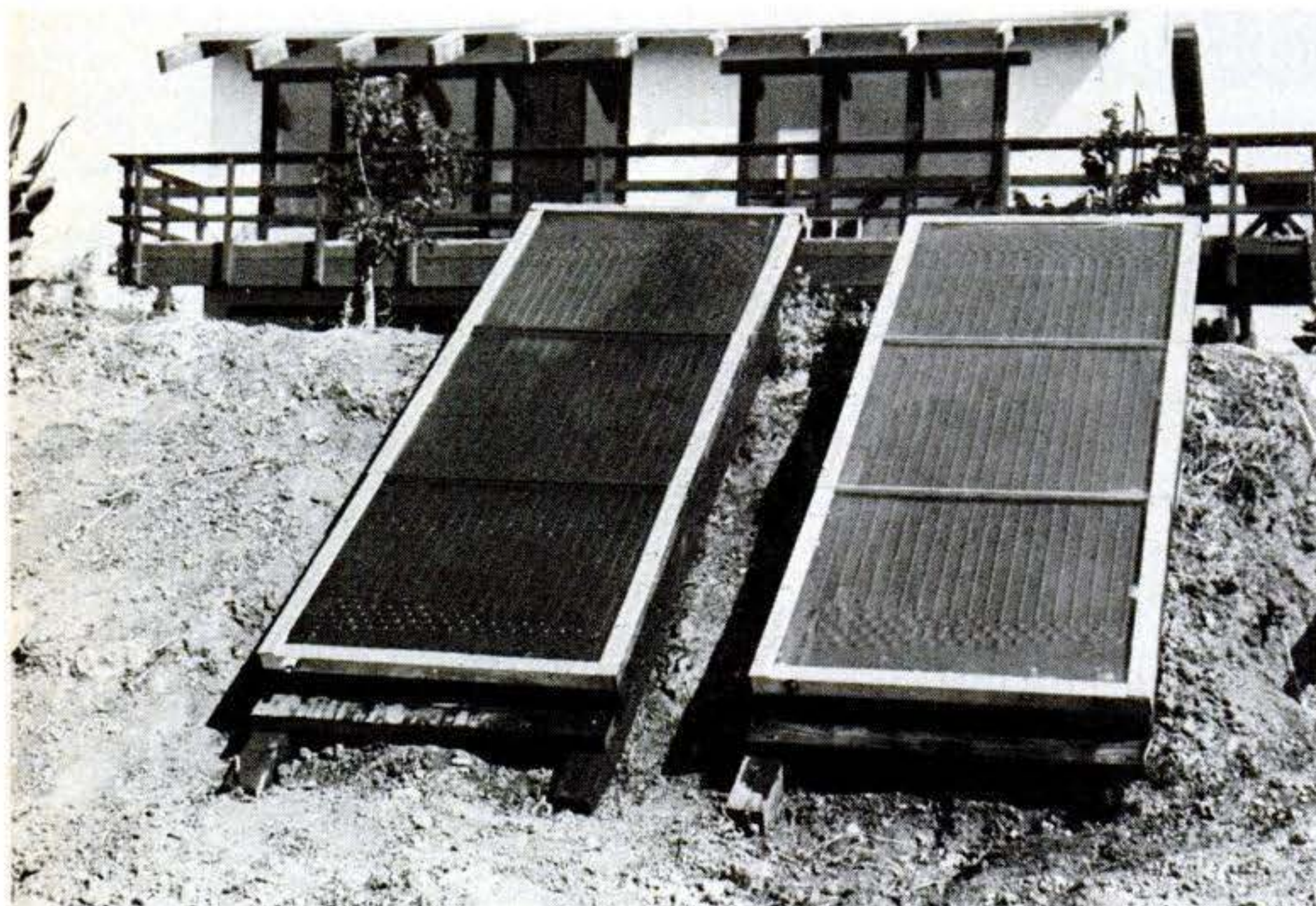
Koolatron Industries Ltd.
56 Harvester Avenue, Batavia, New York 14020
Canada: 230 Bayview Drive, Barrie, Ont. L4N 4Y8
Dept. 1715

SGAF

ADVENTURES IN ALTERNATE ENERGY

A bimonthly sampling of projects PS readers have devised to conserve or replace fossil fuels

Ferro-cement solar collectors for space heating



Anyone can make these rugged and inexpensive collector frames

By **PAUL BOLON**

DRAWINGS BY GENE THOMPSON

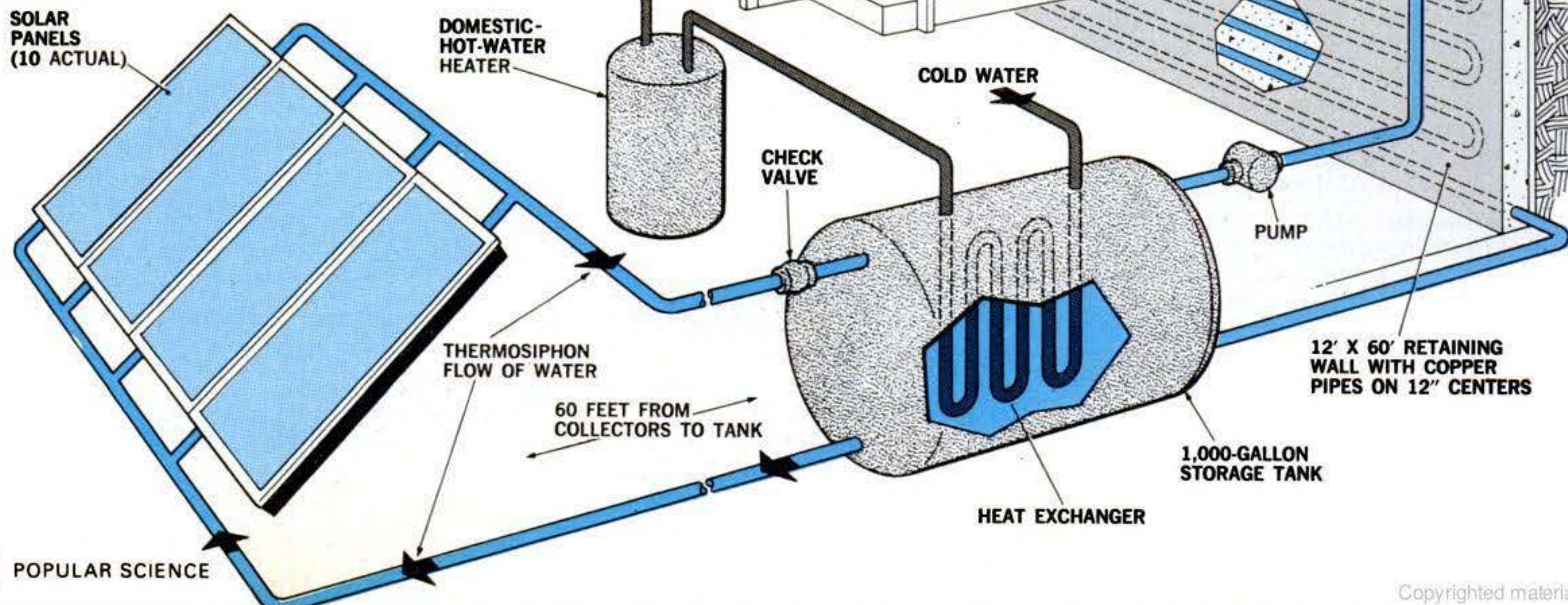
Grass fires and seismic tremors are not usually environmental threats to solar collectors—most reside safely atop roofs. But Arnold Kirkewoog of Livermore, Calif., decided to put his collectors right on the ground.

Besides the usual corrosive attacks of weather and sun, his collectors would have to withstand exposure to the damp earth as well as late-summer grass fires and whipping from the string trimmer he uses to cut weeds. No commercial unit could cope with these conditions; so Kirkewoog, who

Continued

Solar collectors shown above lie on a sloping bank behind Arnold Kirkewoog's home. Hot water from the collectors is stored in a tank (drawing, right) and provides heat for the home when pumped through pipes in a foundation wall. The stored water also preheats domestic hot water.

SOLAR PANELS
(10 ACTUAL)



The possible dream.

Dreams and reality. Mercury's been putting them together for over 40 years, building outboards that last.

And you can get one of these outboards and your own boat at your nearest Mercury® dealer. For less than you think.

Ski. Fish. Relax. You decide. Because when you buy a Merc, you can always count on what's behind you for whatever's ahead.

Every Mercury motor has to prove itself, test after test. So you can be sure of the long-lasting value that makes your Mercury a solid investment.

What's more, every engine carries a one-year warranty on parts and labor. Honored at any of 6,000 Mercury dealers, worldwide.

Go ahead. Make your dream a reality. And let your Mercury dealer help. After all, he knows anything is possible.

Mercury Marine,
Fond du Lac, Wisconsin,
Canada, Australia, Belgium.

MERCURY
OUTBOARDS

A BRUNSWICK COMPANY



Ferro-cement solar collectors

[Continued]



Troweling fresh mortar onto the frame, Kirkewoog works the mixture through several layers of mesh laid over a simple box form, producing a 1/2-in.-thick wall. A

commercial flat metal plate with channels for circulating water (below) fits into the finished ferro-cement box and is covered with lapped panes of glass.

works for the electronic engineering department at Lawrence Livermore Labs, made his own. He considered wood, metal, and even fiberglass before deciding that ferro-cement promised the best solution. The frame, or box, that he has devised has proved strong and durable, and the materials—just sand, cement, and expanded metal—were cheap.

To build the ferro-cement shell, Kirkewoog first made a wood mold and covered it with tar paper. Then he laid up layers of metal mesh over the mold, carefully soldering the mesh to steel angle along the lip and edges. Next he applied mortar to the reinforcing metal and let it cure. After slipping the finished ferro-cement box off the mold, he filled the bottom with insulation. For the collecting surface he installed an Olin flat-plate collector, which has built-in channels for circulating water. The final step was to cover the frame with glass.

Set on an embankment behind his home, his collectors produce hot water that flows via thermosiphon through an ingenious insulated pipe to a storage tank. (The insulated pipe is essential to reduce heat losses and sustain the flow.) A small pump circulates the hot water from the tank through copper pipe embedded in a foundation wall to warm the house. Kirkewoog says he now plans to install a small pump to circulate water through the collectors. On winter days with short intervals of sun, he believes it's possible to store more heat by pumping than by relying on the thermosiphon effect alone.

In Kirkewoog's part of the country it's easy to spend more for summer air conditioning than for heating, and his low-angle roof's chief job is to reflect sunlight away from the house. Elaborate support racks would be needed to mount collectors at a steeper, more efficient angle—so why not keep them where maintenance access is easier?

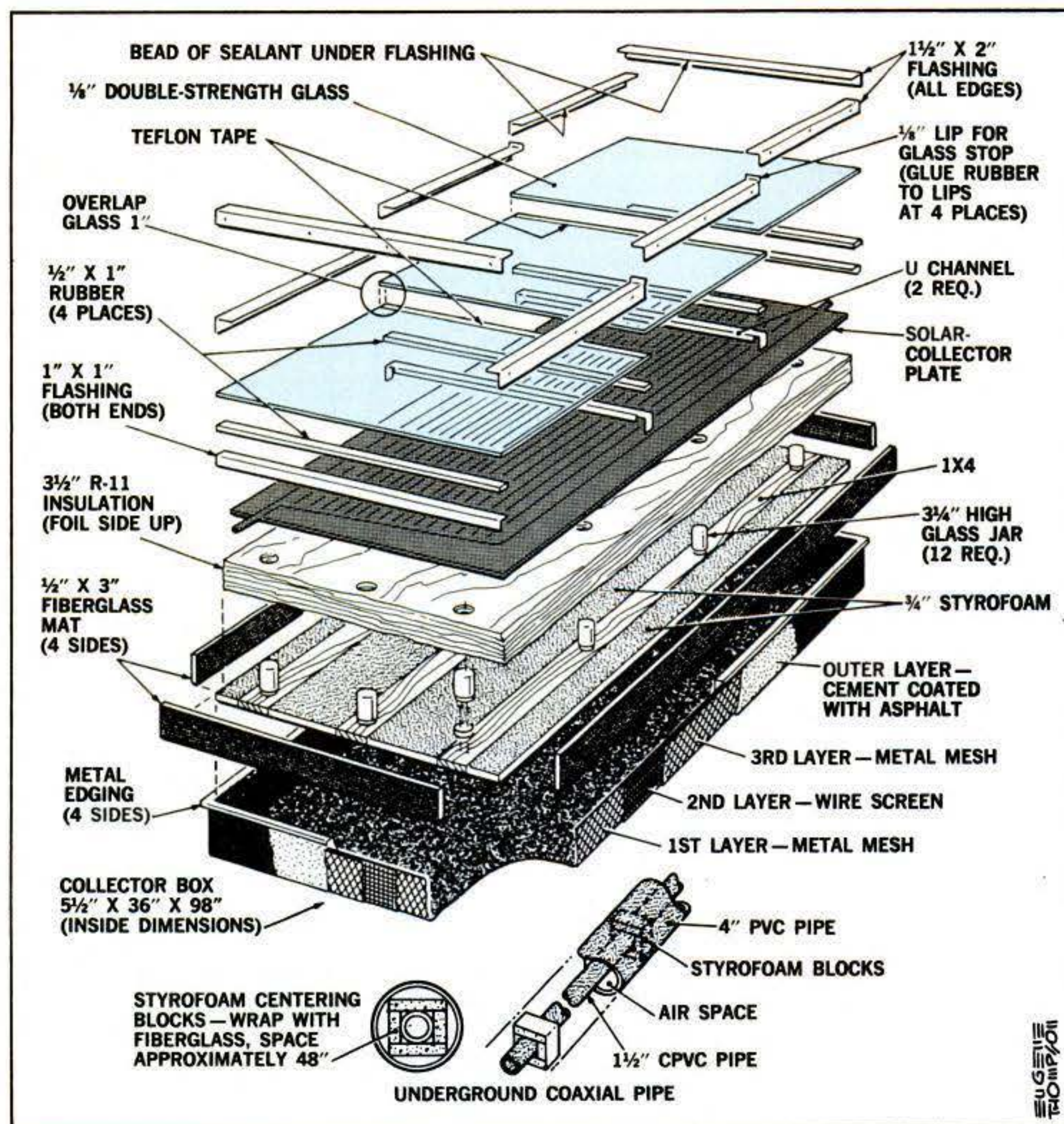
Kirkewoog has assembled his drawings and construction steps into a \$5 packet. Send your check (or query) to Arnold Kirkewoog, 2839 Reed, Livermore, Calif. 94550.

Your idea may bring you \$200

Every other month we present a project developed by a PS reader and pay the inventor \$200. To enter, send us black-and-white glossies (one photo should show you demonstrating the device), plus a description and sketches. Include your name, address, and social-security number. No material can be returned unless you enclose a stamped, self-addressed envelope.

Since space won't permit us to present projects in detail, we'll expect inventors to answer any reasonable query from readers if it's accompanied by a stamped envelope.

Mail entries to Energy Adventure, Popular Science, 380 Madison Ave., New York, N.Y. 10017.



The Guard is America at its best.



You can't train somebody to be a hero. And the Army Guard people on this page would be the last to label themselves that.

But it was Army Guard people like these who helped put a town and its families back together after a tornado had slammed through the countryside. And it's Army Guard people like these, working in their own communities, who have helped neighbors and friends survive everything from floods to blizzards to tornadoes.

Put Army Guard people in situations like those and they perform at their flat-out best.

And you could, too. You've already got the training. You know the ropes. You're ready. And in the Army Guard, you'll keep your vital skills sharp. Emergency-ready. Combat-ready. You'll train in your own community with friends and neighbors. You'll hold on to important benefits, too. Along with your pay and stripes.

But it won't just happen. You've got to do something first. Rip out the attached postcard, fill it out and mail it in. Better yet, call us right now. It's toll-free and won't cost you a penny. The number is 800-638-7600.* Or see your Army Guard recruiter. He

has the whole story. Ask about the benefits that can last a lifetime and the money you'll earn.

Then get on the Guard team. And be your best.

*In Hawaii: 737-5255; Puerto Rico: 723-4550; Virgin Islands (St. Croix): 773-6438; Maryland: 728-3388; in Alaska: consult local phone directory.



POWER TO CAMP OUT OR SHIP OUT

When you're in the great outdoors, you never want to get in a position you're powerless to control. And that's where Honda comes in.

PORTABLE POWER.

The new EM-500 portable generator is the ideal companion for campers and hunters. It gives you a maximum 500 watts of power in a lightweight 40 lb. package about the size of a portable TV.

Whether you need to power your camping accessories, charge your RV battery or just warm-up under an electric blanket, the EM-500 does it quietly and economically—about 4 hours on a tankful of gas.

It's great for small power tools, barbecue motors and electric fans, too. And it can really light-up a camp site.

In addition to the EM-500, Honda has a full line of portable generators from 400 to 4,500 watts.



NAUTICAL POWER.

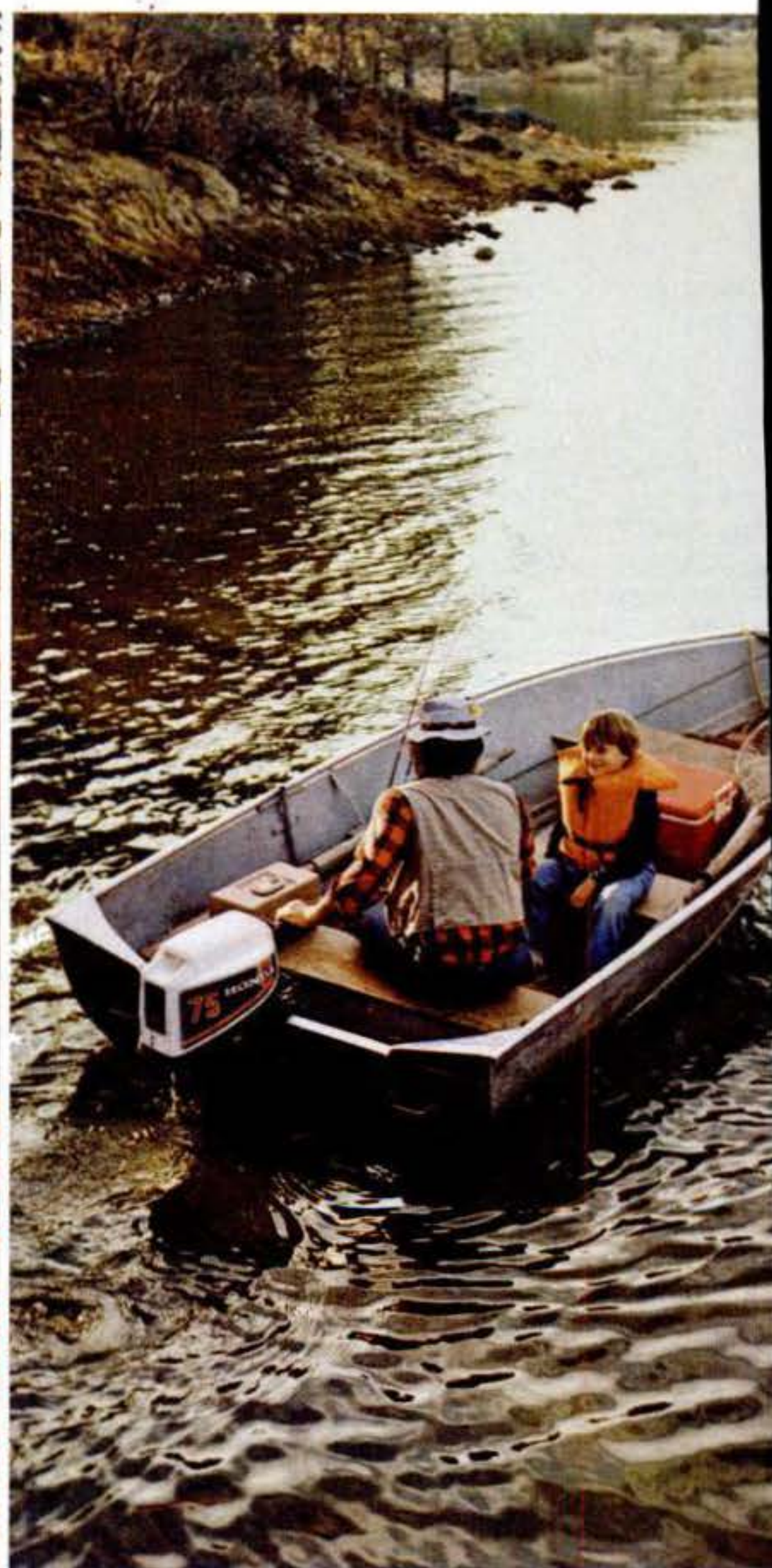
Honda has power for boaters and fishermen, too. A line of 4-stroke outboard engines that come in 7.5 and 9.9-hp models, both with short or long shaft.

Honda's 4-stroke design means quiet operation. Quick response and powerful acceleration. Maximum fuel economy—over three hours on a tankful of fuel under full throttle. Smoother operation. And less pollu-

tion because there's less oil and smoke discharge.

These engines are ideal for trolling. They have the power to keep from drifting at low RPM's without fouling the plugs.

Before you head out on your next trip, let your nearby Honda dealer tell you about Honda power. Just look in the Yellow Pages or call toll free 1-800-228-2056, ext. 640, or in Nebraska, 1-402-571-4900, ext. 6.



IT'S A HONDA

THROUGH THE VIEWFINDER

By EVERETT H. ORTNER



Order out of chaos

Was that beautiful white church with the slim spire in Salem or Marblehead? Were those rocky beaches in Newburyport or were they on the other side of the Massachusetts border in New Hampshire? Or maybe even up in Maine? And where did you shoot that roll of film with those austere Greek Revival houses? Stonington, Conn., or Groton, Mass.?

If you've ever been on a long trip during which you took a lot of pictures, you know the problem of identifying scenes a few weeks—sometimes even a few days—after you've returned home. Cities and landscapes melt into each other. A Gothic church so memorable that you shot half a roll of film on it turns out to resemble closely another memorable Gothic church. Which was the cathedral of Bayeux?

I used to endure that agony after a trip—of trying to arrange 20 or 30 rolls of film so I could identify towns and buildings by the sequence in which the pictures were taken. I no longer have that problem. I now use a simple system, invented by me, that eliminates it. Here's what I do before I go on a trip:

I start with a sheet of small stick-on labels, about an inch square in size. I number each label, one for each roll of film. I put the sheet of labels in my camera bag. That's all, in the way of preparation.

Now I'm traveling. After I expose each

roll of film and put it back in its plastic container, I do one other thing before I drop the container into the bottom of my bag: I peel a label off, starting with number 1, and stick it to the container. When I get home, every roll of film will have a number showing its place in the overall sequence.

At home, I have two ways of getting my film processed: I can mail it to a lab or I can leave it with my local camera store for processing. Here's what I do in each case:

With the mailers, when I fill in my return address I give myself a different middle initial for each roll of film. With roll number 1, my middle initial is A. With number 2, it becomes B. And so on. Those return-address labels are cut off by the processor and used to mail the film back to me. "Everything you put on the return label comes back to you," says Darrell M. Shark, customer service specialist at Kodak's Fair Lawn, N.J., processing lab.

I do much the same thing if I take my film to a camera store for processing. As the clerk puts each roll of film in an envelope, I write my sequence number on the claim check that he gives me. When I get the film back, it is easy to identify the box of slides or package of prints.

A big advantage of my system is that if a roll of film is missing, I can guess accurately where and when it was taken, and might even recall its subject matter. Two years ago, for example, when only 29 rolls

out of 30 came back from the processor, I could tell that roll 29 (addressed to "E. C². Ortner") was absent, and I knew where its pictures were taken. However, the best-laid schemes gang aft a-gley, as the poet says: In this case, while I got a nice letter and a roll of replacement film from Kodak, somebody else must have ended up with my pictures of Polish farms and churches between Cracow and Warsaw, taken on the afternoon of September 21, 1979.

Try my system. It works (usually).

Leapfrog

For a long time, Mamiya, the Japanese camera manufacturer, seemed to lag behind its competitors in features and technology. In the last couple of years, however, beginning with the Mamiya ZE 35-mm SLR [PS, Aug. '80], the company has not only caught up, but seems to have leapfrogged the opposition with some nice little features. New products in the works (and to be distributed in the U.S. by Bell & Howell-Mamiya Co.) include:

- The Mamiya U—a tiny, 35-mm clam-shell camera, smaller, it's claimed, than the littlest Rollei 35's or the Olympus XA.

- The Mamiya ZE-X—an SLR with both aperture and shutter priorities, a "cross-over" mode that enables it to change an unshootable setting, and a jack for remote infrared control.

- Three small, lightweight movie cameras (carrying the Bell & Howell name) that emit audible squeaks to tell you whether the batteries are okay or whether you have left the battery switch on.

Getting closer

One trouble with most amateur portraits is that they're taken from too far away. The pro almost always moves in close. Now Kodak's new Colorburst 350 instant camera gives the amateur a chance to shoot like a pro. Flick a switch and a close-up lens moves into place, providing a focusing range of two to four feet—perfect for head-and-shoulders shots. Price of the 350: \$96.50. PS



MOTORCYCLING

By RAY HILL

Dual-purpose BMW



"Bigger is better."

If that's your credo, BMW has something for you: the world's largest-displacement dual-purpose motorcycle, the R80 G/S. It is shaft-driven, weighs about 400 lbs., and displaces nearly 800 cc. Tires are special-treaded dual-purpose Metzlers designed for speeds up to 110 mph.

Basically a reworked street bike, the R80 is relatively lightweight—compared with similar displacement street machines. BMW's design includes various weight-cutting schemes, including plastic fenders, a single-arm swing arm (which contains the drive shaft), lighter exhaust system, and a lighter clutch-flywheel assembly.

Who will buy this machine? According to BMW spokesmen, the most probable buyer will be the street or touring rider who encounters unpaved roads on his journeys or likes to take an occasional off-road foray. I rode the bike briefly, and it seemed light and responsive on the asphalt (although I didn't have a chance to really push it through any demanding curves). It handled much better than did an equivalent street bike on an unpaved mountain road and a desert trail.

Although the machine has off-road capabilities, it is not a trail bike. Its weight, wide flat-opposed twin-cylinder engine, and relatively soft short-travel suspension make it impossible for the bike to compete effectively against 200- to 250-lb. narrow single-cylinder trail machines with long-travel suspensions.

How many people are interested in a street bike with mild off-road capabilities and a price tag of \$4,800? Probably not many—especially when you consider that you could buy both Kawasaki's street KZ 750 and dirt KDX 175, recognized as outstanding in their respective habitats, for

\$2,899 and \$1,499, and still be \$400 under the Beemer's price.

I would rather ride a good street bike (which the R80 is) in the street, and a good dirt bike (which the R80 is not) in the dirt. But perhaps there are a lot of riders who feel otherwise. BMW certainly hopes so.

Electronic cruise control

A motorcycle's throttle-return spring does two things: It closes the throttle when you release it, and it gives you a sore wrist on long rides. There are various mechanical devices available to hold the throttle in one position, some of which work pretty well. The recently introduced M-300 electronic cruise control looks like it will work even better, primarily because it's easier to release and reset than most of the mechanical units.

A push-button affair, it mounts next to the throttle handgrip. Push the button at the throttle setting desired, and it holds the throttle there. Push it again and it releases. Applying the brakes releases it, too. It's \$49.95, from Moe's Cycle Supply, 2424 Hanford Rd. S.W., Atlanta, Ga. 30315.

Energy and off-road bikes

About 12 million people use five million off-road motorcycles for recreation and competition each year. Here are a couple of interesting energy facts from the Motorcycle Industry Council about these machines:

- Off-road motorcycles use only 0.08 of one percent of the gasoline consumed in the U.S. each year.

- A typical off-road bike uses 18.8 gallons of gasoline per year—about one-third the amount wasted by an untuned car engine during a 12-month period, or about half the energy consumed by a TV set in a year.

One year on a Suzuki 1100

When Suzuki introduced the GS 1100 a little over a year ago, the motorcycle immediately jumped to the top of the super-bike class—the fastest street bike ever to roll off the assembly line. But there is more to this machine than raw power, as I've learned from riding it 5,000 miles during the past 12 months.

Although capable of awesome acceleration, it's docile in traffic and easy to ride, has excellent brakes, and has been completely reliable. All I've done in 5,000 miles is change the oil, adjust the valves and drive chain, and change one rear tire. The front tire is still okay, but the rear was

nearly bald at 4,000 miles (a common occurrence with large, powerful bikes).

Fuel consumption was excellent. Riding sedately, I had no trouble averaging in the 50–55-mpg range. Not surprisingly, that figure drops considerably under hard riding.

Lack of a reserve-fuel petcock and jerky carburetion are the only complaints I have about the bike. Suzuki says both problems have been eliminated on the '81 machines. The carburetion has been adjusted to eliminate the jerkiness; reportedly these adjustments have made the bike slightly faster, too. And there is a reserve petcock on the '81 bike.

Wheel-rim protectors

Changing a tire on a large motorcycle without scratching up the aluminum wheel rim in the process is a problem. Plastic rim protectors available at Honda dealers help you avoid scratching the rim.

For about \$2.50 you get three plastic covers that fit over the edge of the rim. Your tire irons press against the plastic instead of the rim. If the dealer doesn't have them in stock he can order them. The part number is 07772-0020201.

Reading and riding

The Motorcycle Safety Foundation is a national nonprofit organization funded by the five major motorcycle makers—Honda, Yamaha, Kawasaki, Suzuki, and Harley-Davidson. The Foundation has a large number of printed and audio-visual materials available to new riders, educators, safety personnel, researchers, and the motoring public. A few items are free; most are not. Two important free pamphlets:

"What You Should Know about Motorcycle Helmets" describes helmet standards and structures, with tips on purchasing and caring for a helmet.

"The Motorcyclist and Protective Gear" covers face shields, goggles, helmets, footwear, gloves, and clothing necessary for safe riding.

To obtain these pamphlets or a list containing the entire library of materials available, write to Order Department, Motorcycle Safety Foundation, 780 Elkridge Landing Rd., Linthicum, Md. 21090.

Turbocharging

At press time, chances are good that Honda will release a turbocharged version of the popular CX 500 water-cooled V-twin. Yamaha is also experimenting with a turbo on its XS 1100. Whether it will become a production item is not yet known.

New super-bike king?

Kawasaki's Z-1 used to dominate the super-bike class. Then the other three Japanese makers got interested in the big-bike go-fast market, and Kawasaki was relegated to an uncouth back seat. In an effort to regain the front-runner's spot, Kawasaki engineers developed the GPz 1100 with fuel injection. I'll be riding it soon. Stay tuned. P5

STP Gas Treatment does it all. Here's why it outsells them all.

At today's prices, drivers are demanding more and more from their gasoline. And more and more from their gas additives.

STP Gas Treatment delivers what drivers ask for. It's the Driver's Edge. It provides protection for your fuel system. Removes water that can cause problems. Inhibits rust. Cleans your carburetor. And keeps it clean to save you gas.

STP does it all. That's why it outsells them all.

Removes water— fights gas-line freeze.

Water gets into your gas tank through condensation and, sometimes, by contamination at the pump. This water can cause poor engine performance and, in cold weather, gas-line freeze.

But the special-action formula of STP Gas Treatment used regularly works to protect your fuel system. It surrounds water droplets and helps carry them through your engine. And the less water in your fuel system, the less chance of a problem.

Inhibits rust.

Even a little rust can cause serious fuel system problems. It can clog your fuel filter, or block your carburetor jet. This can mean hard starting, plus stalling and sputtering.

But STP Gas Treatment has a special rust and corrosion inhibitor designed to prevent these problems. Both these steel bars were soaked in gasoline plus water. But the bar on the right—the one without the rust—was protected by STP Gas Treatment. No wonder it's the Driver's Edge.



Cleans carburetors and keeps them clean.

Normal engine heat and oxidation cause gum and varnish to build up. These deposits can clog openings, reduce tolerances and harm engine efficiency.

STP Gas Treatment cleans your carburetor. And works two ways to prevent these harmful deposits from accumulating again. First, it coats

metal surfaces which works to prevent gum and varnish molecules from getting a toehold. And second, it surrounds these molecules with a stick-proof coating so they can pass harmlessly through the fuel system.



UNTREATED

TREATED

The carburetor sleeve on the left shows fouling and deposit accumulation. The one on the right—the one that still looks like new—was protected by STP Gas Treatment. Which would you want in your engine?

Saves gas.

A dirty carburetor lessens your engine's operating efficiency, reduces mileage, wastes gas.



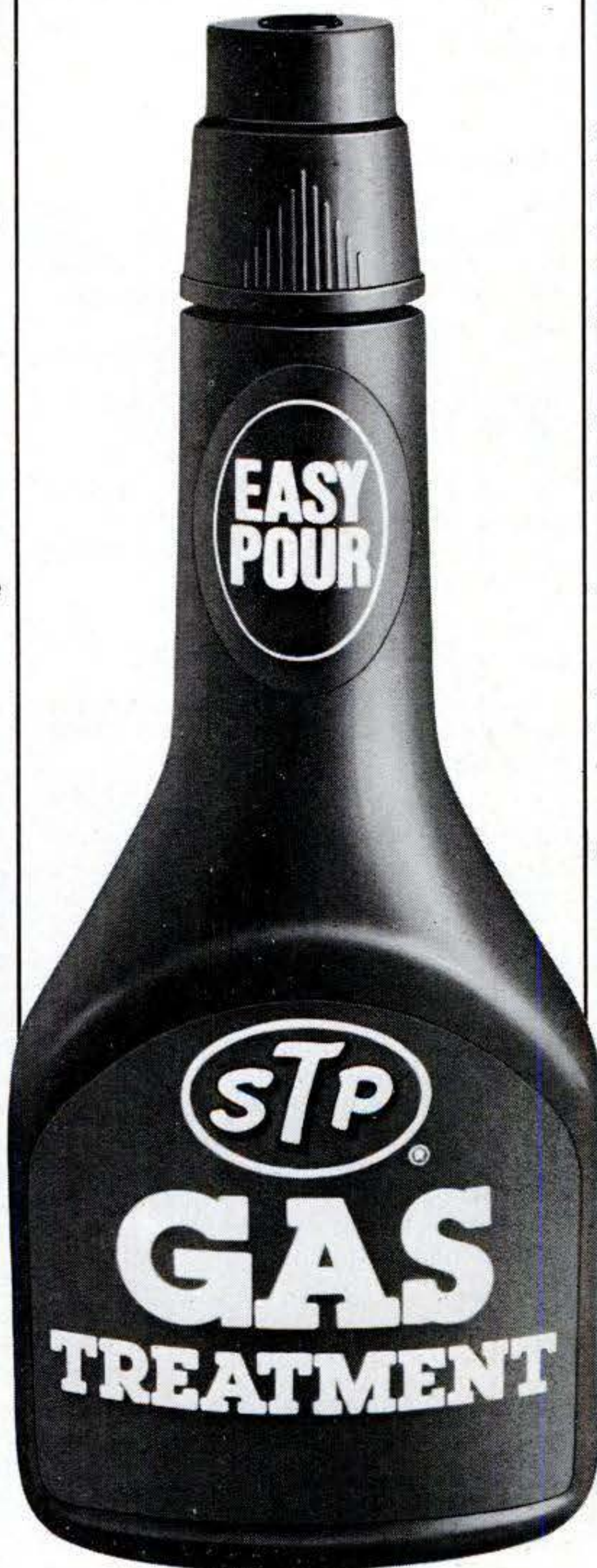
But STP Gas Treatment cleans carburetors. Intake valves and manifolds, too. And, used regularly, **keeps** them clean. Net results: improved engine efficiency and important gas savings.

Get the Driver's Edge.

If you demand more from your gas—and more than many gas additives even promise—join the millions of smart drivers who demand STP Gas Treatment. Keep it on the job—every mile, every fill, every season. Because STP Gas Treatment **delivers. Satisfaction guaranteed or your money back.**

STP Gas Treatment **does it all.** Removes water, fights gas-line freeze, cleans carburetors, saves gas. That's why it **outsells them all.**

The driver's edge.



"SAY, SMOKEY—"

A clinic on cars by Smokey Yunick, America's most famous mechanic

Bad rings?

How can I determine if oil is going by the rings or valve seals in my 1974 Ford Maverick six-cylinder 200 engine? I experienced no problem with oil consumption until after I had the head rebuilt by a very reliable shop. The machinist says he put in valve seals that could not possibly leak. Number-three plug oil-fouls in 100 miles unless I use an anti-fouling adapter. Compression in number-three cylinder was 146 lbs. before the valve job, and 150 lbs. afterward. Before the head rebuild I had to put in a quart of oil about every 2,000 miles. Now I must put in a quart about every 300 miles. I don't notice much smoke from the exhaust after warmup. The engine runs smoothly, starts easily, and has good power for its age. Gasoline consumption is slightly higher than normal. The machinist says the rings are probably bad. I think there is something wrong with a valve-guide seal in that cylinder. How can I check to see who is right?

Dick Yates, Claysville, Pa.

A proper check of the valve seal means removing it to really know. It can be done with the head on the car. Put compressed air in the plug hole to hold the valves up.

High oil consumption after a valve job usually means rings are gone or stuck. A valve job increases vacuum and here comes the oil.

Using oil

My '74 Chevy Blazer 4WD has 74,000 miles on it, and its 350 V8 needs some help. For the first 60,000 miles or so it ran fine, burning no more than a quart of oil in 1,000 miles. I bought a boat this year (weight with trailer is 2,500 lbs.), and since I started towing it, my plugs (AC 44T's) are completely fouled with brownish deposits every 2,000 miles. And oil consumption is up to a quart every 400–500 miles. Once the plugs are replaced, the engine runs fine (although I can't brag about the power) and idles with 17 inches of vacuum.

With a Sun leakage tester I checked all cylinders, and they varied from about nine to 14 percent, which seems pretty good. I could hear no leaks anywhere (tailpipe, carb, etc.). Compression checks out at 125–135 lbs. and increases very little when I squirt oil in the cylinders. From this, am I correct to deduce valve-guide problems? What do you recommend?

Ray Kawal, Anchorage, Alaska

Cut down oil consumption first. That will require new and better valve seals, such

as those made by Perfect Circle. Then check piston rings. Look for sticking compression and oil rings. More rings get ruined than worn out. Often they collect combustion and oil residue and stick in their lands, then lose their seals. This reduces heat transfer, which anneals the ring.

Bore condition is important, but so are piston-ring lands.

Oil and compression leaks cause deposits, which, among other things, ruin spark plugs prematurely. Good ignition is, of course, important. Are you sure yours qualifies in all ways?

Premature rust

I have a 1977 Dodge Charger with a rust problem—four small blisters and other rough spots along the lip of the trunk. Have you had any other complaints about this?

Richard L. Decus, Oxnard, Calif.

I haven't seen many paint complaints on Chrysler products. Sounds like your problem occurred because the area was not clean and neutral to begin with. The paint chemically refused to bond normally. Strip clean and redo it. That should take care of things.

Dual exhaust on a diesel?

Is there any advantage or disadvantage to having a dual exhaust installed on a 1980 Buick diesel?

J. E. Bosco, Milwaukie, Ore.

Don't waste your money on duals, assuming you're using your car for standard transportation.

Squealing bothers him

My 1977 six-cylinder Pinto station wagon has about 32,000 miles on it. Approximately 1,000 miles ago the power steering began squealing on turns. After making a turn and traveling a short distance the car would squeal again a few times. Then it would stop squealing. The power-steering fluid is okay. What's wrong?

E. Benedict Markus, San Diego, Calif.

You may simply have a loose or worn belt on the power-steering pump. Check it.

Engine dies

I have a 1970 Cadillac (82,000 miles) with a 472-c.i.d. engine, automatic transmission, and air conditioning. The car runs fine below 60 degrees F. Above 60 degrees, after about 20–30 minutes of driving, the en-

gine starts cutting out at 55 mph, then 40, 30, 20, until it eventually stops. Once the car stops it will restart and run for a couple of minutes—until I get home by repeating the above procedure. I have been to three garages, and \$300 later I still have the same problem.

These items have been replaced: carburetor, fuel pump, rubber fuel line, distributor cap, points, condenser, coil, spark plugs, and spark-plug wires.

The following items were checked: fuel delivery, distributor timing, compression—all at spec. The valve tappets are quiet. The car was tried without the air cleaner to check the hot-air temperature device—same problem.

The problem persists without air conditioning, on high-test gas or regular. Vacuum readings are normal. The distributor advance was checked and is at spec. Ballast resistor is okay. Help!

Ted Madison, Windsor, Conn.

Take the time and trouble to get the car to behave this way when a mechanic with some tools is present. Before you take off, rig up for a quick visual check of the spark at the coil's distributor connection. If that's okay, you have the problem cornered: It's a fuel problem.

Change clearance for synthetic?

In my spare time, I help some friends race drag boats and drag-race cars. I've told them about the things that you've found out about synthetic oil, and I'm trying to get them to switch this year.

The engines are all Chevys and run between 454 and 500 cu. in., single and double four-barrel, some iron and some aluminum rods. Pistons are TRW or better.

If possible, I would like to know what clearances have to be changed if we switch to All Proof synthetic oil (piston, rods, and crankshaft).

A. H. Dombrowski, San Diego, Calif.

My experience with synthetic oil (polyol ester and diester) is that no change in clearance is necessary with mineral oil. Stay with what works best.

When to change oil

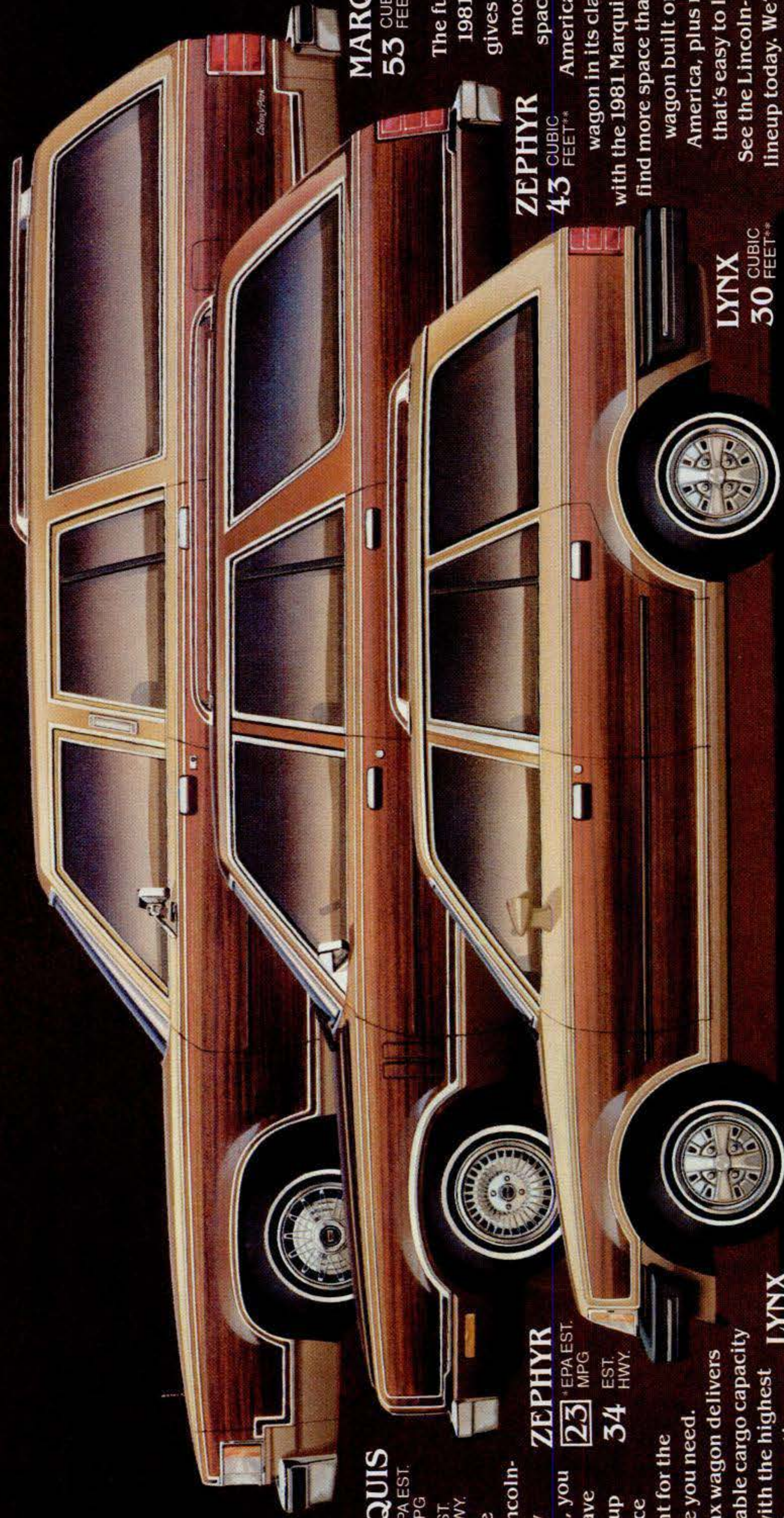
Based on reports I'd read in Popular Science, I decided to switch my 1977 Corvette to Mobil 1 oil. Since I put only about 3,000 miles on it per year (most of it city driving), I was hoping that once a year would be often enough to change the oil and filter. Is this a safe practice?

Paul R. Castle, Rock Island, Ill.

You're in good shape—once a year, 3,000 to 5,000 miles.

Each month, Smokey Yunick answers questions on cars—family cars, high-performance models, and racing vehicles. Got a problem? Send it to: "Say, Smokey—", Popular Science, 380 Madison Ave., New York, N.Y. 10017. Smokey reads all letters, answering those he feels are of widest interest. Due to the large volume of mail, Smokey cannot reply to letters that are not answered in his column.

SPACE STATIONS



MARQUIS

16 *EPA EST.
MPG

25 EST.
HWY.

With the
1981 Lincoln-
Mercury

wagons, you
don't have
to give up
the space

you want for the
mileage you need.

The Lynx wagon delivers
remarkable cargo capacity
along with the highest
EPA mileage rating
of any wagon ever
built in America.

ZEPHYR

23 *EPA EST.
MPG

34 EST.
HWY.

LYNX

27 *EPA EST.
MPG

42 EST.
HWY.

MARQUIS

53 CUBIC
FEET**

The fuel-wise
1981 Zephyr
gives you the
most cargo
space of any
American-built

ZEPHYR

43 CUBIC
FEET**

wagon in its class. And
with the 1981 Marquis, you'll
find more space than in any
wagon built or sold in
America, plus mileage
that's easy to live with.
See the Lincoln-Mercury
lineup today. We've got a
wagon that's waiting for you.

LYNX

30 CUBIC
FEET**



LINCOLN-MERCURY DIVISION

MARQUIS, ZEPHYR, AND LYNX FROM LINCOLN-MERCURY

*Compare to estimated MPG of other cars. Your mileage may differ depending on speed, weather conditions and trip length. Actual highway mileage and California ratings lower.

**Based on EPA Interior Volume Index figures. All comparisons exclude other Ford Motor Company products. Buy or lease at your Lincoln-Mercury Dealer's.

8 mg. "tar", 0.8 mg. nicotine av. per cigarette by FTC method.



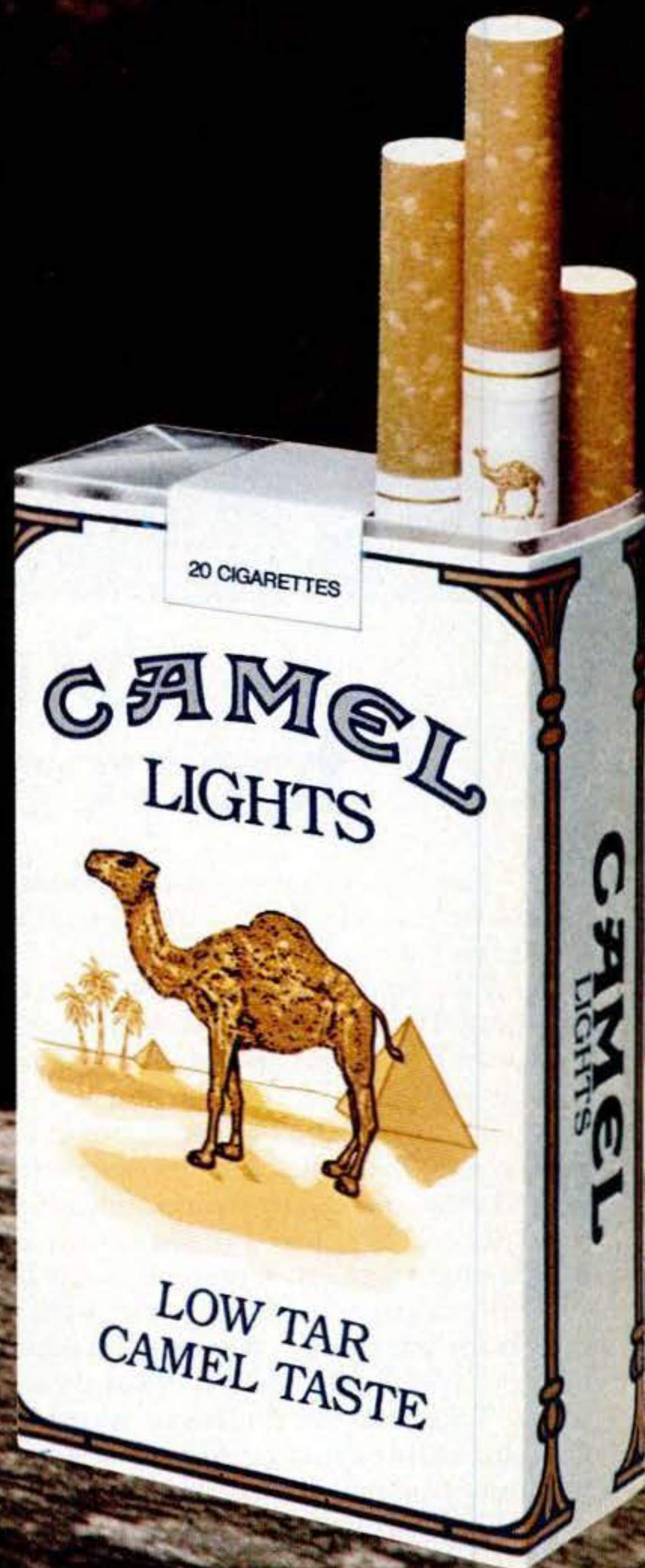
Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health.

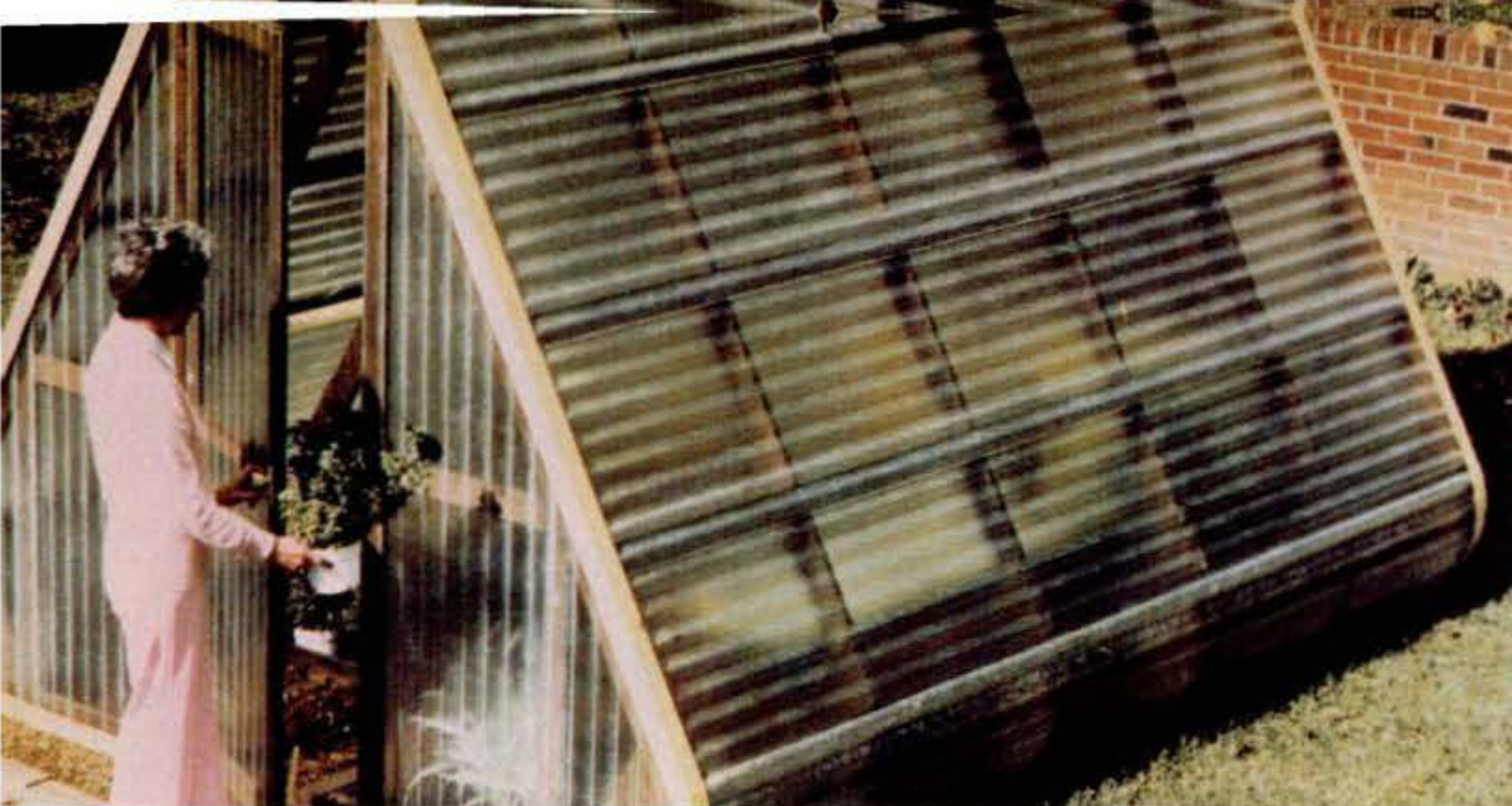
CAMEL

Where a man belongs.

**Camel Lights.
Now in a new pack.
Same low tar,
same Camel taste.**

8 mg
tar.





Summer projects for year-round enjoyment

You've got a great idea for a summer project...and we've got a great idea to help you build it. Do it now. It's easy when you build it with Filon fiberglass panels.

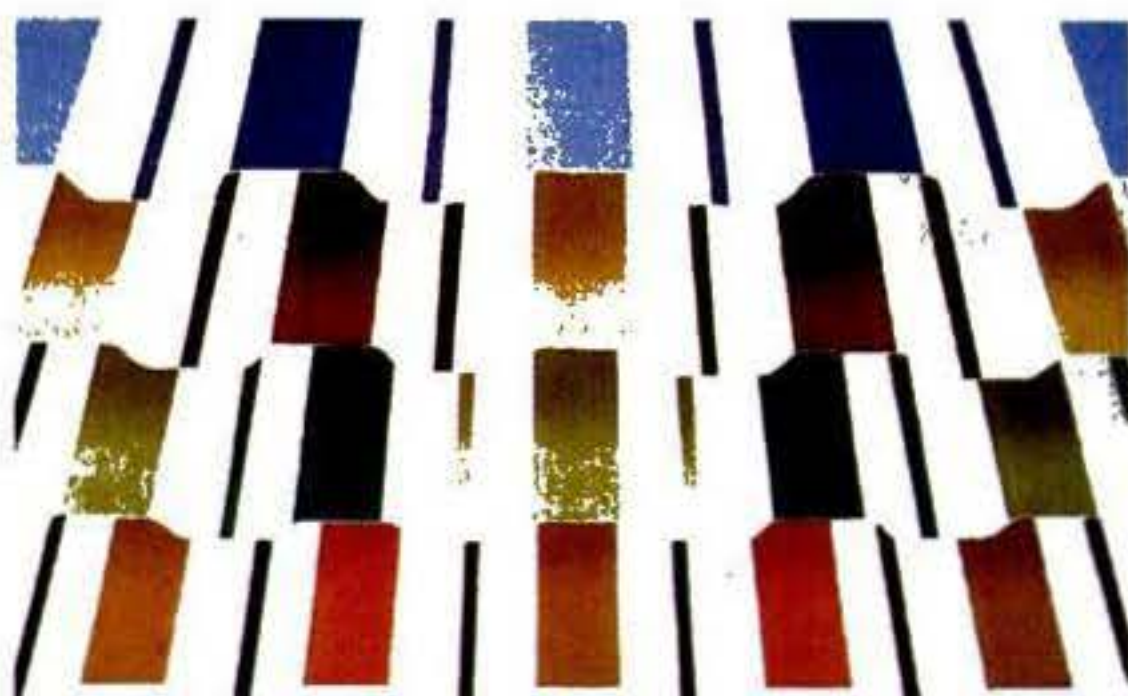
Filon premium panels are light but extremely tough and shatter resistant. The average panel weighs only about 6 pounds. It's easy to work with, can be cut and drilled with ordinary hand tools and can be handled easily by one person.

Filon panels add beauty and value to your home. You can select "just the right panel" from the world's largest selection of architecturally pleasing ribbed shapes and corrugated styles for your summer project. You can choose from decorator colors and patterns to complement your home decor, from panels engineered to screen out solar heat and harmful ultraviolet rays, panels specially designed for maximum plant growth for your home greenhouse, panels for your solar project, even panels that look like 2" x 2" wood strips but give you the protection of solid roofing.

Take your great ideas to your Filon Dealer. He's got everything you'll need including Filon building plans for most do-it-yourself projects. In case he's out of plans, write to us at Filon. We'll send you a complete list of available plans by return mail — most plans \$1.00.

FILON
DIVISION OF **VESTRON** CORPORATION

Discover the many worlds of Filon.
12333 South Van Ness Avenue, Hawthorne, CA 90250



Bat with a bend



No, that baseball bat is not warped, and there's nothing wrong with our photo. The aluminum bat is made with an angle just above the handle.

Why? Because the barrel of the bat is out in front of the hands when it hits the ball. With a conventional bat, the swing and transfer of weight must be exactly synchronized so the barrel can catch up with the hands and hit the ball solidly. But with the 19-degree curve in Hillerich & Bradsby's Big Bend bat, the barrel is already three to five inches ahead of the hands, so no catch-up is required. This increases the probability of solid contact, says Bill Williams, vice-president of H&B (Box 35700, Louisville, Ky.).

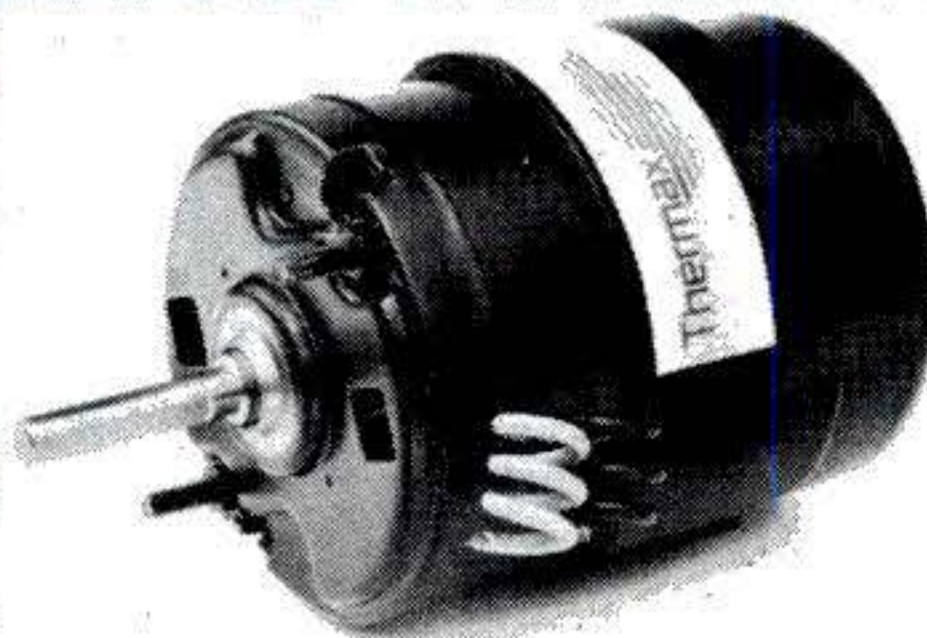
The Big Bend also prevents either early or late rollover of the wrists, claims Williams. With an ordinary bat, the roll of the wrists must be perfectly timed with the moment of impact to maintain a level swing. But because of the Big Bend's design, the wrists do not roll over until after the batter has swung through the hitting area. The batter is, therefore, better able to control the bat, it's claimed.

H&B (which also makes the famous Louisville Slugger) is quick to point out that the bat will not transform everyone into a consistent hitter. Nor will it necessarily hit the ball farther than any other bat. It is designed merely to help improve timing and control.

The bat is said to conform to all known specifications, but is available only in aluminum. Amateur leagues and organizations should be individually contacted regarding specific rulings on its use. Price: \$25 to \$50, depending on size.—T. O. Bakke

FREE ELECTRICITY!

START GENERATING YOUR OWN POWER
FROM RENEWABLE ENERGY SOURCES
BUY THIS GENERATOR — GET FREE PLANS



THE AMAZING TC25G PERMANENT MAGNET LOW-RPM DC GENERATOR

SO SENSITIVE that it acts like a selsyn when connected to a small dc motor! Turn the TC25G generator shaft with your fingers and the motor rotates by the same amount — in either direction!

SO EFFICIENT that it can produce 12 volts at under 400 rpm!

SO POWERFUL that it can deliver over 6 amperes into a short circuit!

How did such an unusual generator get built? Here is the story:

The TC25G began as one of many components, of a unique low-cost wind generator — the TC25 Helius Rotor. It was during the development of this new rotor that our engineers discovered there was no inexpensive, low rpm generator to be found anywhere, that was suitable for small windpower converters — or, for that matter, for water wheels, pedal power, solar engines, fuel powered generators, or any other small energy needs.

It was tempting at the time to turn to "small" automotive alternators — which need several thousand rpm to generate the kind of voltage we wanted. They are large, heavy and also require an efficiency-killing step-up pulley to achieve the necessary rpm to generate power from a small water wheel or windmill.

DESIGNED FOR THE NEW ERA OF RENEWABLE ENERGY SYSTEMS

Meanwhile, the price of oil and other fuels was just starting to skyrocket. Many energy-conscious people had made up their minds not to take these price hikes lying down. More and more people were thinking seriously of switching to free renewable energy sources — solar, wind, water — simply because it had begun to make good economic sense. Needing to produce exactly the right product for the growing boom in home-sized alternate energy products, Thermax engineers started from scratch to design the perfect small generator. It had to be inexpensive, light, and operate efficiently at low rpm (which no other small generator could do).

The result was the TC25G permanent-magnet dc generator — which may be exactly the generator you've been looking for. At the Energy Lifestyle Show, visitors who tried our demonstration generator were so amazed by its sensitivity that some even looked underneath to see if there was a trick to it! Many enthusiasts bought generators on the spot.

PERFECT FOR OWNER-BUILT SYSTEMS

At first, Thermax sales personnel were surprised that so many customers were attracted by the generator alone and didn't want to buy the whole windmill kit. Even without advertising, inquiries kept coming from do-it-yourself energy enthusiasts who wanted to build their own power systems, not Thermax's or anyone else's.

So here you are — the ideal small dc generator, with plans (if you need them) to build several different renewable energy converters. Now you can start generating your own free, natural energy!



1 MILL STREET, BURLINGTON, VERMONT 05401

SPECIFICATIONS: TC25G GENERATOR

Two-pole permanent magnet dc generator.
Ten-slot armature wound with 0.4 mm (26 AWG) wire.
Internal resistance 7 ohms; heavy-duty long-life brushes.
Mounts by two 10-32 studs at shaft end of case.

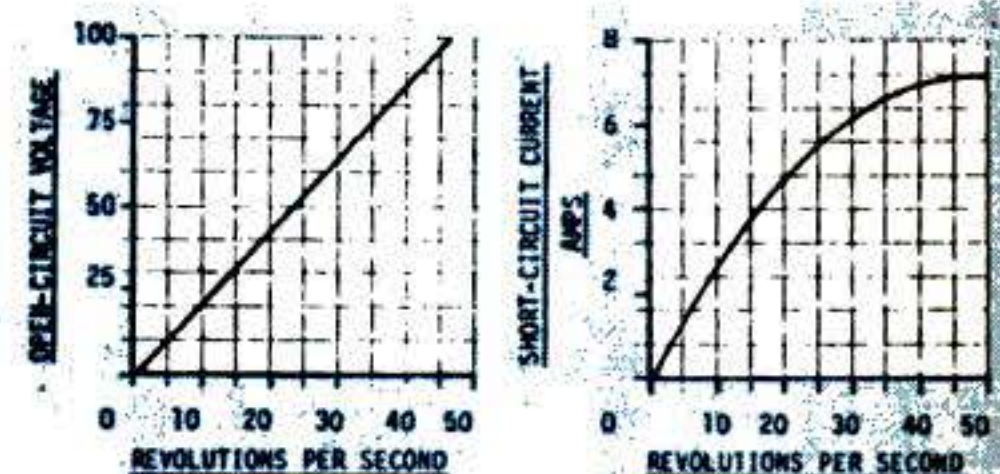
New! Steel flux augmentation ring now supplied with each generator.

Dimensions:

Case length	4-7/8 inch	(124 mm)
Case diameter	3-1/2 inch	(88 mm)
Shaft diameter	5/16 inch	(7.94 mm)
Weight	4 lb.	(1.8 kg)

Electrical Performance

Rated for 12 volts dc, will generate 6, 12, 24 or 32 volts with appropriate voltage regulator.



FREE PLANS AND USER'S GUIDE

Order your TC25G now and receive, free with your generator, a complete applications guide: all you need to know about wiring, voltage regulators, batteries, inverters to step up to 110 volts ac, as well as plans for building one of the following energy producers:



HELIUS TC25K
WINDPOWER CONVERTER

WIND POWER The TC25G is already standard equipment in Helius rotor kits. You can build your own wind generator from plans furnished. (Plan P1)

WATER POWER If water power is available you can build your own small hydroelectric generating station. (Plan P6)

PEDAL POWER Convert an old bicycle to generate power: pedal your television set! (Plan P11)

BEGIN YOUR ENERGY INDEPENDENCE TODAY!

SPECIAL OFFER

YES send me _____ TC25G generators and plans now for only \$69 each (two for \$130), plus \$4 each for shipping and handling in CONTINENTAL USA. Vermont residents, add 3% tax.

☐ My money order or check is enclosed.

My choice of free plans is: (Check one for each generator ordered)

☐ P1 Wind power

☐ P6 Water power

☐ P11 Pedal power

NAME _____

PHONE _____

STREET _____

CITY _____

STATE _____

ZIP _____

THERMAX CORPORATION

1 MILL STREET, DEPT. PS 8
BURLINGTON, VERMONT 05401

INSTANT ORDER DESK

(Credit card customers only)

CALL TOLL-FREE 800-451-3402

(In Vermont call 802-658-1098)

In Canada call 613-678-3322

Satisfaction guaranteed: if you are not completely satisfied with your TC25G generator, return it to Thermax in original condition within ten days of receipt for a prompt refund.

Digital multimeter sets range automatically

A volt-ohm meter offers the quickest and most accurate way to pinpoint most problems in electrical circuits for household, automotive, and electronic equipment. I've long recommended using volt-ohm meters for all do-it-yourself appliance repairs.

In recent years, digital VOM's with electronic readouts have expanded the accuracy and speed of testing. But these newer meters still require care to select the proper range as well as function.

If, for instance, you have a VOM set

on a 2.5-volt DC scale while testing a dry-cell battery, then place it across a 12-volt automotive circuit and forget to change the range selected, you could damage some meters, bending the pointer or destroying electronic components. Others could give erroneous or inaccurate readings.

Radio Shack's 22-196 digital VOM has solved that problem by incorporating range-seeking circuitry that automatically locks into the highest range needed to give you an accurate readout. The meter advances in "steps" to that range; you can lock it on a lower range for fractional accuracy when desired, overriding the auto range.

Auto polarity

You also don't have to worry about connecting the proper leads to positive and negative poles, because polarity is selected automatically, too. An inter-



nal replaceable fuse in the battery compartment guards against damage caused by touching the probes to a live circuit with the function switch set to the OHMS selection. I found it to be one of the most convenient test instruments I've ever used.

To use it, simply set the meter to one of four functions: DC VOLTS, AC VOLTS, K OHMS (thousands), or DC MILLIAMPS. Then turn the power switch on and touch the probes to the circuit to be tested. The value appears in 0.4-inch LCD numerals in the display window. The meter measures up to 1,000 volts DC, 500 volts AC, 200 milliamps DC, and 20 megohms resistance. It also has low-battery and overrange indicators. It can be used with either a nine-volt battery or AC adapter. The 22-196 sells at Radio Shack stores for \$99.95, plus \$4.95 for the adapter.

—Evan Powell

Get a Grip on a Grizzly.

Pick up an Uncle Henry® Grizzly lockback and feel the heft of a knife made to take anything you can dish out. Handles of virtually indestructible Staglon® give you a grip you can be sure of. A Schrade + Steel® blade means the Grizzly is completely rust resistant. Uncle Henry even guarantees this lockback against loss for one year from registration. So, get a grip on a Grizzly.™ You can't lose.

**UNCLE
HENRY**
SCHRADER

For more information write for your free Old Timer® Almanac to Schrade Cutlery Corp., Ellenville, N.Y. 12428.

Forming A Corporation

Not Just For The Wealthy

With a small, one-person business, the advantages can be tremendous

Maybe you think forming your own corporation is just for the rich. Many people believe that. But it's just not true. Nearly all wealthy people own corporations. But anyone can form one at surprisingly low cost.

Thanks to a revolutionary new method, you can set up your own corporation without expensive lawyers, all by mail and without ever leaving home. And it's 100% safe, ethical, and legal.

Your own small corporation is our country's number one way to financial success. This year the IRS tells us there will be at least 5,000 new millionaires. Over 95% of them built their fortunes through a privately owned corporation. Therefore, a successful, privately owned corporation represents the best of the American Dream.

And you don't need a big staff or big money.

Most corporations are started with little or no capital, and with only one employee—the owner.

A business revolution has occurred in recent years. Nearly half a million people have already been helped in forming small corporations with the aid of a remarkable book. It's called: *How To Form Your Own Corporation Without A Lawyer For Under \$50* by Ted Nicholas. It's now in its fully revised and updated 12th edition. And now you can get your own personal copy to examine—without risk—to learn how a corporation applies to you and how you can reap maximum benefits.

Most men and women who have used the incorporation system outlined in the book are simple one-person business operations. These businesses were often started on a part-time basis by people right in their own homes. You'll save from \$300 to over \$2,000 in unnecessary legal fees by the do-it-yourself simplified method. Tear-out forms are right in the book; certificate of incorporation, minutes, by-laws, everything you need. And you can complete the forms in less than five minutes!

You too can start your small business corporation in your spare time while you keep your present job. Another possibility is that you may be able to turn your present job into a corporation of your own. And you'll be shown exactly how to do this.

Your own corporation gives you personal protection. Your personal liability will be limited just to what you put in the corporation itself. Your home, furniture, cars, and personal cash are all protected in the event of any business disaster.

You'll see how to begin with little or no

capital—zero capital, if you prefer.

All you need is a marketable idea, product or service. Then your potential for building real wealth is enormous. Ted Nicholas' remarkable book will help trigger many new ideas.

Your own corporation can be used as a personal tool to gain all types of legitimate tax deductions. It will become *the ultimate tax shelter* for you. For example, a new car purchase or lease is tax deductible over the life of the car. So are gasoline expenses and repairs. The same goes for other equipment used in your business. There are *hundreds* of legal tax deductions.

If you have an office at home, you can pay rent to yourself and get tax deductions for doing so.

You may choose to set up a lucrative pension and profit-sharing plan with yourself as the main beneficiary. You can gain far greater benefits than unincorporated people do.

As an owner of a corporation, you'll have plenty of company. Over 30,000 new ones are formed each and every month. Ninety-eight per cent of them are small businesses, often just one individual working from home.

We live in a land wherein the corporation is king. Even the government recognizes this. To encourage small business expansion, the tax on small corporations was recently *reduced* to only 17% of up to the first \$25,000 in income. And this is *after* all the tax deductions have been taken.

As attractive as it is, incorporation is not

Reader and Reviewer Comments about this remarkable book:

"Would have been deterred from incorporating if we had to use normal routes and expenses."

Michael G. Bate
Independent Carpets of America, Inc.
Rochester, NY

"This book succeeds...because it fills a real need. Brought public information that previously had to be bought from an attorney."

Publisher's Weekly

"Anyone thinking of incorporating...should not skip any pages."

Sacramento Bee

"Impressed by speed, efficiency and cost."

Roger Beardwood
Woodcat Investments, Inc.
France

for everyone and may not be for you. However, the book will help you decide if it would be advantageous for you now or perhaps later. All the advantages and disadvantages are reviewed. If you decide to incorporate, it can be done by mail within 48 hours. You never have to leave the privacy of your home.

The author started his business without any capital at the age of 22. Without credit or experience, he raised \$96,000 to begin a confectionary business. From that starting point grew a chain of 30 stores. At the age of 29, he was selected as one of the outstanding businessmen in the nation. This resulted in an invitation to the White House to meet the President.

He wrote the book *How To Form Your Own Corporation Without A Lawyer For Under \$50* because he felt many more people could become corporate presidents of their own companies. The book has become the largest single source of new corporations in America.

Just picture yourself president of your own corporation. The book gives you the information you need to make your decision.

As a bonus for ordering the book now, we'll send you absolutely free a portfolio of valuable information. It's called "The Income Plan" and normally sells for \$9.95. It describes a unique plan that shows you how to convert most any job into your own corporation. You'll increase your take-home pay by up to 40% without an increase in salary or even changing jobs in many cases.

If you are an employer, learn how to operate your business with independent contractors rather than employees. This means that you'll have no payroll records or withholding taxes to worry about. And you'll be complying with all IRS guidelines. "The Income Plan" includes forms, examples and sample letter agreements to make it possible.

As publishers, we guarantee your purchase in the fairest way known. If you feel the book is not all that we've described, return it undamaged within two weeks and we'll promptly and courteously refund your money. If you should decide to return it, you may keep the bonus, "The Income Plan", for your trouble.

To get your copy, write the words "Corporation Book and Bonus" on a plain sheet of paper, along with your name and address. Enclose a check or money order for \$14.95. There is no sales tax on your order and your purchase price is tax deductible. Mail your order to Enterprise Publishing, Inc., Dept. PO-16C, 725 Market Street, Wilmington, Delaware 19801.

DETROIT REPORT

By JIM DUNNE

Big future for small diesels

American cars that get 40 to 50 mpg in highway driving will soon be commonplace. Within a couple of years new, small diesel engines coming from all the U.S. car makers will account for 10 to 20 percent of new-car engines. GM says it plans to equip 25 percent of its 1985 fleet with diesels, and the other auto makers will follow as soon as engines are available.

The sources are varied. GM will buy a 1.8-liter four from Isuzu, then build its own three-, four-, five-, and six-cylinder diesels in this country to complement the V8 it now offers. Ford is concluding agreements with Mazda and BMW for four- and six-cylinder diesels—to be used in the smallest and largest cars in its lineups for 1983 and beyond. Chrysler is looking to Mitsubishi and Peugeot for four-cylinder engines. The company also has long-range plans to convert its new 2.2-liter gasoline four to a diesel. And American Motors can call on the diesels made by Renault for its small-car and 4WD-truck needs. If needed, AMC could convert its new four-cylinder gasoline engine, which the company successfully cut from its 258-cu.-in. six.

But the future isn't all diesel. "We're still learning how to build more-efficient gasoline engines," says Russ Gee, chief engineer for Chevrolet. "If we continue this way, future gas engines will nearly match the economy of diesels."

End of the line

A year ago, Chrysler announced a "permanent" shutdown of its big-car assem-

bly plant in Detroit, but later revived it as part of the federal loan-guarantee agreement. But 1981 sales of New Yorker, Newport, St. Regis, and Gran Fury models didn't justify the reprieve, so now the plant has been closed again. This time it's for good. Chrysler's big-car lines will be produced no more. In their place, Chrysler will offer new top-line models in the LeBaron and Diplomat series.

Smart transmissions

Automatic transmissions have always relied on mechanical vacuum switches for gear selection. Now that's changing. With electronics taking over more and more car functions, transmission control was an obvious candidate. The first electronic transmission will be on some '83 or '84 V8 Caprices, controlled by the same computer that regulates air-fuel delivery. The computer will select the most efficient gear settings after weighing such factors as car speed, accelerator setting, and emissions levels. Long predicted for the industry, electronic controls are certain to dominate automatic-transmission design in the near future.

Once more, with feeling

It seems incredible now, but five years ago—when GM built its first smaller-size family sedans—some company officials thought the change was too drastic. The doubters figured that buyers wouldn't like the change that, for example, cut 1,000 pounds and two feet of length off the 1977 Caprice. The nay-sayers were proved wrong, of course, and the company

embarked on a \$40 billion program to shrink all of its cars to a more fuel-efficient size by 1984. As part of that program, full-size models are getting a second overhaul for 1983—of the same magnitude (mini-tude?) as the '77 cuts but also including such innovations as front drive and four-cylinder engines. The changes will affect all of GM's big-car lines except those of Pontiac, which will soon abandon the full-size-sedan market altogether.

Meanwhile, even before the current round of cuts is complete, GM is planning to go through its line again in the latter half of the 1980's. It will be another \$40 billion spending spree, but this time the emphasis will be on refinements and the automated construction of cars. The plan reflects GM's thinking that computers and automatic equipment in assembly plants are the wave of the automotive future.

Body building

The continuing need to slash weight has led auto manufacturers to seek alternatives to the all-steel body. Aluminum is increasingly common for hoods, deck lids, station-wagon floors, and other parts. Plastic is becoming the material of choice for front and rear panels, bumper covers, headlight and taillight housings, and modesty panels. Oldsmobile made news last year with its plastic front fenders on the Omega; and Corvette and the Pontiac P-car are set for all-plastic skins for 1983. Still, you won't see an industry-wide changeover to the lighter, corrosion-resistant materials. The aluminum industry cannot supply all the metal needed to replace steel, and the supply of plastic is dependent on the supply of petroleum, a commodity that gets costlier and chancier each year.

One step forward, one back

The new V8 engine being planned for Cadillac models in 1982 will have a modern aluminum block to save weight, but the overall design will revert to iron cylinder sleeve inserts. Other aluminum-engine designs use bare-aluminum cylinder walls, which can be assembled more easily than the insert type. It looks as if Cadillac plans to play it safe to avoid the problems Chevy had with the aluminum-block Vega. The 250-cu.-in. V8 will have a short production life, however. It will be replaced by a 185-cu.-in. V6 in 1984.

400,000 fixes

Diesel-engine problems that are caused by governor weight-retainer rings in the fuel pump will be fixed under warranty on all 400,000 diesel V8 engines built by Oldsmobile for passenger cars and light trucks. The policy, prompted by a rash of complaints from owners, gives the diesel owner a five-year, 50,000-mile warranty on the pump instead of the 12-month, 12,000-mile coverage originally offered. GM found that excessive water in diesel fuel—a common problem—could cause ring failure. Owners who had pumps replaced or rings repaired at their own cost may be eligible for reimbursement. [E]

Braking news: how to save fuel—and body work

As everyone should know by now, coasting to slow down your car can save a lot of gas. Keep your foot off the brake by anticipating traffic lights and stop signs, and you'll extend fuel economy. But by how much? A new study by GM quantifies the savings. On average, half of the total tractive energy delivered to the wheels of a car is used in acceleration. Of that, two-thirds is dissipated in braking—wasted. Stay off the brakes completely, then, and you'd save a third of every tankful of fuel. That's not practical, of course, but it suggests that by changing your braking habits only moderately you will still pocket significant savings.

Sudden braking can cost in another way, too: Body-shop work on a crumpled rear end. An unrelated survey by a

utility company found that rear-end collisions would be reduced by more than 50 percent if all vehicles carried a centrally located brake light set high up on the rear of the body. The study tested 5,400 vehicles in the company fleet over a period of 12 months, during which 55,000,000 miles were logged. Half the fleet was equipped with the special stoplights and had 16 rear-end collisions. The rest weren't modified, and they had 37 such accidents. The results are consistent with an earlier study of taxicabs that showed rear-end collisions were reduced by 54 percent when cabs used the special stoplights. To date, only Toronados built in the mid-1970's have offered such lights as standard equipment, but you can install your own with parts from auto-supply stores.

Make sure you're serious.

Before you even consider buying a Jeep Cherokee, make sure you're serious. Because there are plenty of choices out there, including Broncos and Blazers. But only one is born of the rugged Jeep legend. And we consider Cherokee the best sports utility vehicle available in America today.

That's a pretty big statement for any vehicle to back up. But Cherokee doesn't back away from a little healthy competition.

Its 4-wheel drive system is built in from the ground up, not added on. It has an integral steel roof, not plastic. It comes in 2-door and 4-door models, unlike its biggest competitors. And 95.8% of all Jeep vehicles registered in the last 10 years are still in operation today*. Nobody can match that record.

A serious off-roader is more interested

in what a vehicle can do once its wheels start rolling. Here's how Pickup, Van & 4WD experienced Cherokee's performance: "Climbed at little more than an idle. Although deeply rutted...the hill was no problem."

Cherokee's ride: "Exceptionally comfortable...its wide radials and anti-roll bar certainly contributed."

Cherokee's handling: "Behaved more like a sports car than a sports utility. In one package...good looks, great performance, super fuel mileage* and excellent quality control."

Remember, we didn't say it, *they* did. But if you're as serious about 4-wheel trucking as we are, you owe it to yourself to get behind the wheel of a genuine Jeep Cherokee. Then make your decision.



JEEP CHEROKEE 4-DOOR MODEL



16
EST. 21 HWY
MPG. *TEST.

 **Jeep Cherokee. The Truck.**

AT AMERICAN MOTORS

* Figures are for comparison. Your results may differ due to driving speed, weather conditions and trip length. Actual highway mileage will be less. California mileage will be different. • Jeep Corporation, a subsidiary of American Motors Corporation.

† Based on R.L. Polk & Co. registrations through July 1, 1979.

Popular Science Book Club tells and shows you exactly how to save

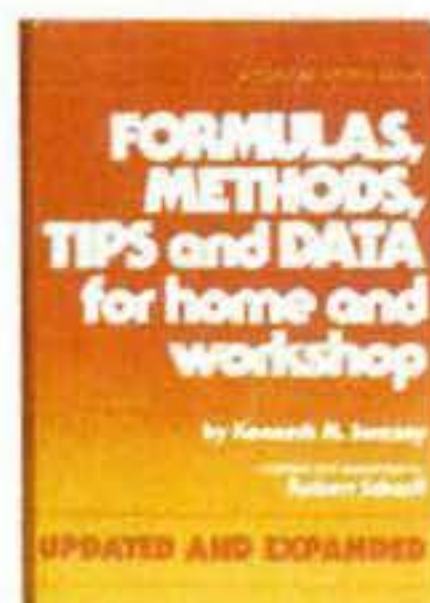
Do it
yourself
and do it
right!

Take any 3

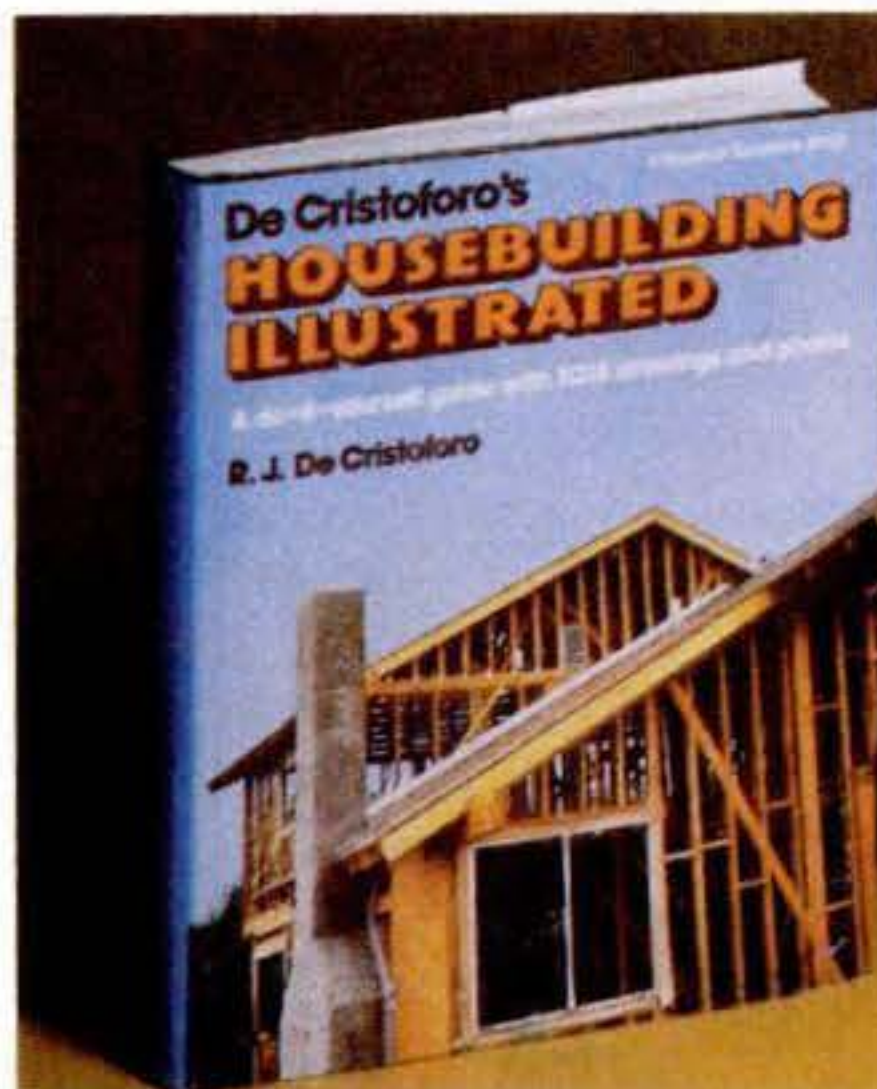
Choose from this giant list of
best-selling handyman books!



★097. Do-It-Yourself Plumbing. Pub: \$12.95



★042. Formulas, Methods, Tips & Data for Home & Workshop, Pub: \$15.95



★116. DeCristoforo's Housebuilding Illustrated. Pub: \$18.95



★109. Basic House Wiring. Pub: \$13.95



2349. Homeowner's Handbook of Plumbing & Repair, Pub: \$15.95



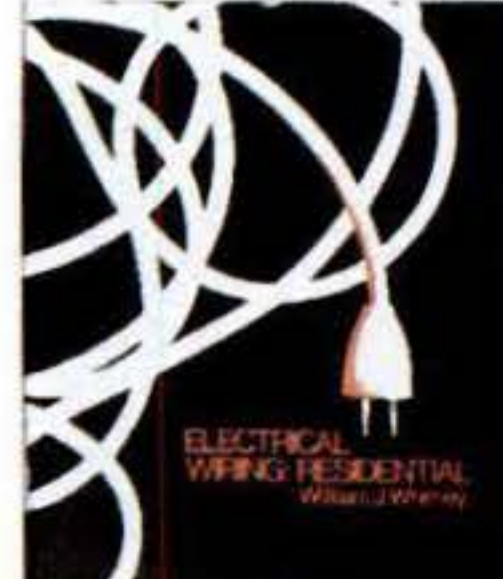
★161. Leisure Homes. Pub: \$18.95



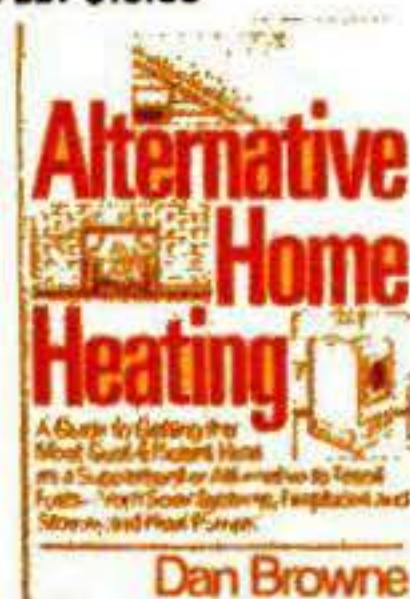
0212. You Can Renovate Your Own Home. Pub: \$14.95



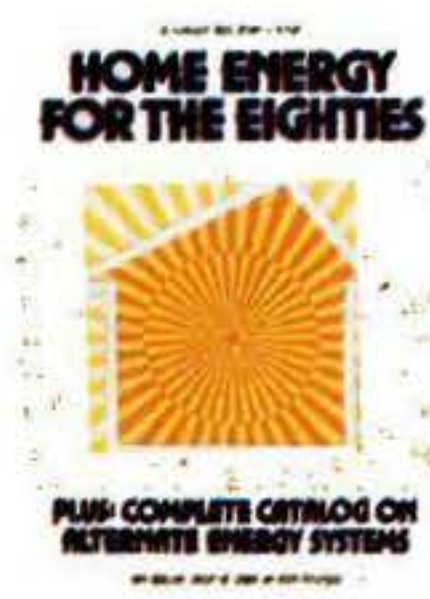
0214. Do-It-Yourself Roofing & Siding. Pub: \$8.95



0246. Electrical Wiring—Residential. Pub: \$14.95



5561. Alternative Home Heating. Pub: \$12.95



5560. Home Energy for the Eighties. Pub: \$10.95



5515. Successful Putting It All Together. Pub: \$11.95

Get the *specific* handyman how-to you need!

Take your pick from this best-selling list of easy-to-understand, lavishly-illustrated handyman books. Each written by a do-it-yourself expert. Each loaded with step-by-step instruction you can really use *now*!

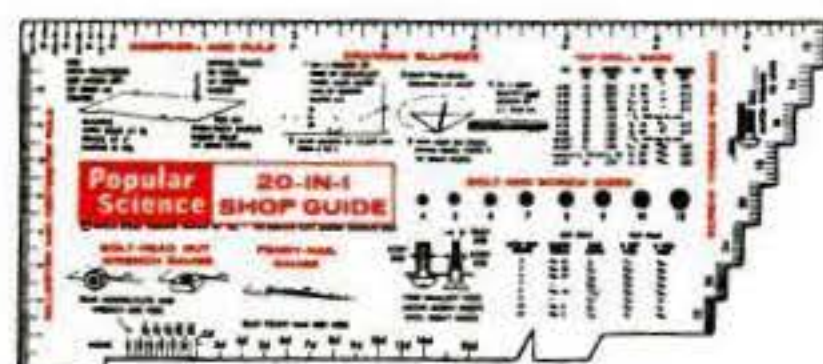
Just look it up and get the easy answers. Everything from how a part or system works... to planning, building, and installing your own brand new projects. Whether you're a beginner or a seasoned do-it-yourselfer, these books help you save time, effort, and dollars every time you use them.

That's what Popular Science Book Club is all about. As a Club member, you have the opportunity of seeing hundreds of brand new, hard-to-find handyman books published each year. These include the best how-to books from publishers all over the country—along with many original custom-written Popular Science Books (see titles with asterisk *) commissioned specially for the Club and available nowhere else at discount.

Yes, as a member of PSBC you can save up to 50% and sometimes more on hundreds of special bargain books offered each year... books on: home repair and improvement, house building, wiring, plumbing, concrete, masonry, woodworking, workshops, furniture building, energy, insulation, appliance repair, cars and car repair, electronics, machines, technology and much more.

To protect your biggest investment—YOUR HOME—and to do all kinds of home repair and improvement projects like a pro, these books are a must and a giant bargain! Mail the card today.

FREE
when you
join



POPULAR SCIENCE 20-IN-1 MEASURING TOOL

See details
on opposite
page...

Mail attached card today!

If card is missing, write to:

POPULAR SCIENCE BOOK CLUB

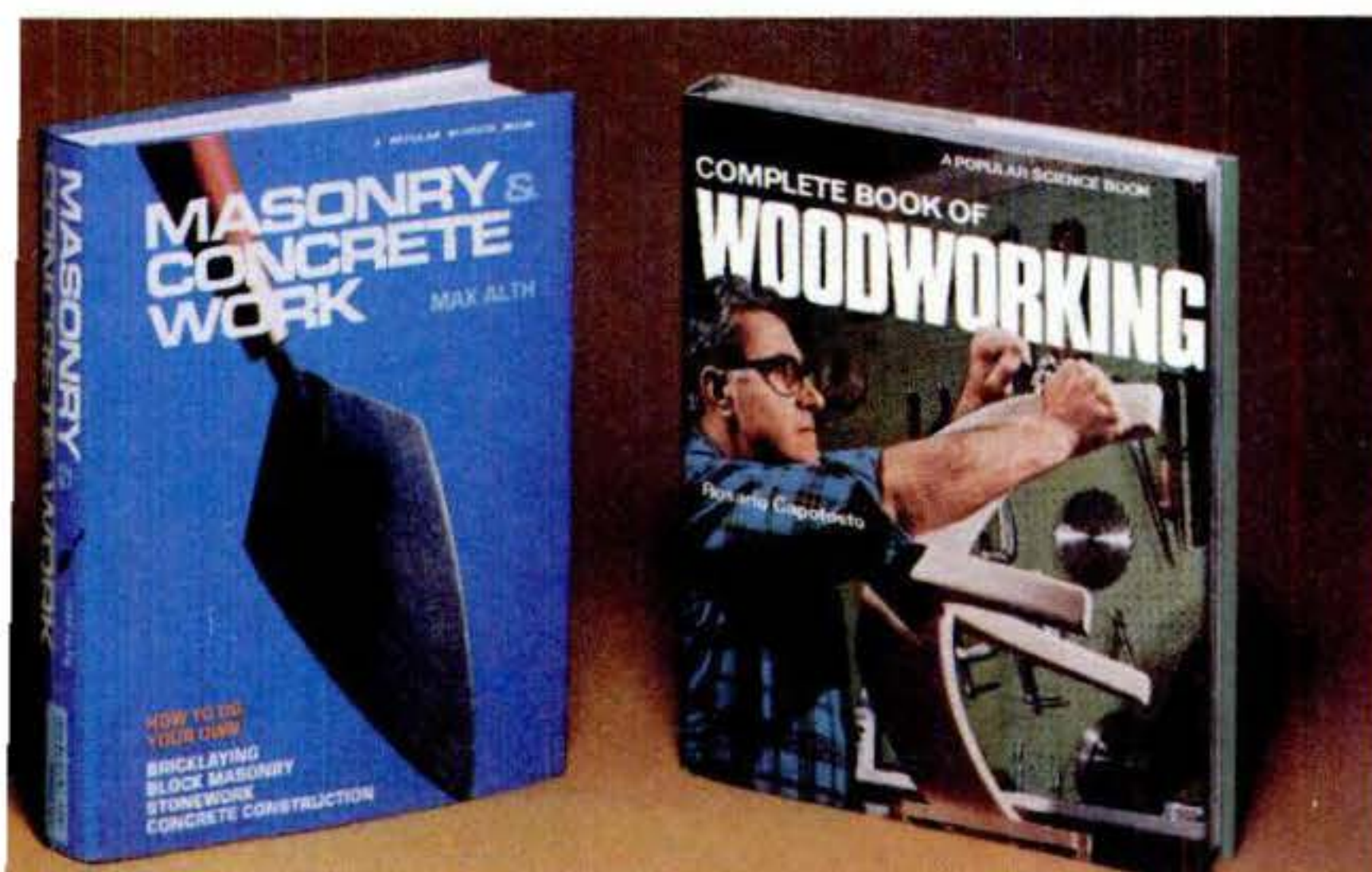
P.O. Box 2006, Latham, N.Y. 12111

nty on every home repair, improvement and fix-it job you'll ever do!

for only \$3.95

Values up to
\$60.85

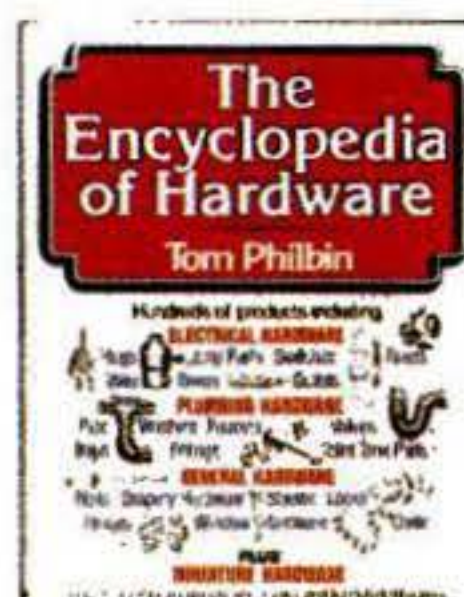
your welcome to Popular Science Book Club



★089. Masonry & Concrete Work.
Pub: \$14.95

★105. Complete Book of Woodworking.
Pub: \$16.95

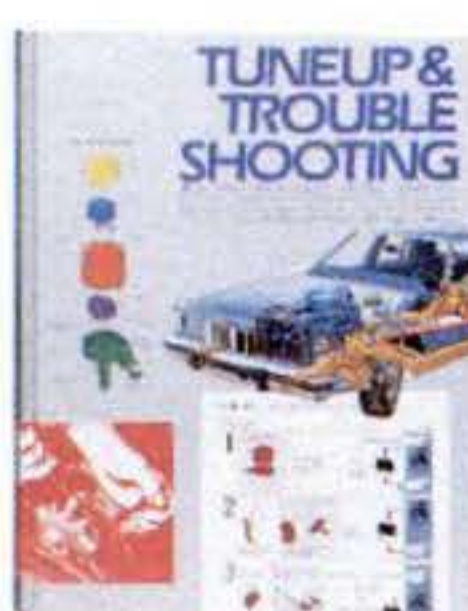
You simply agree to buy just two more regular selections or alternates within a year—from the hundreds of brand new handyman books offered to you each year.



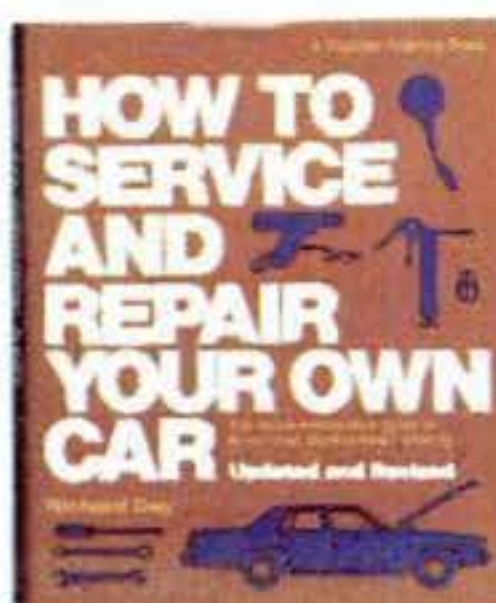
0228. The Encyclopedia of Hardware. Pub: \$12.00



5513. Brakes. Pub: \$14.95



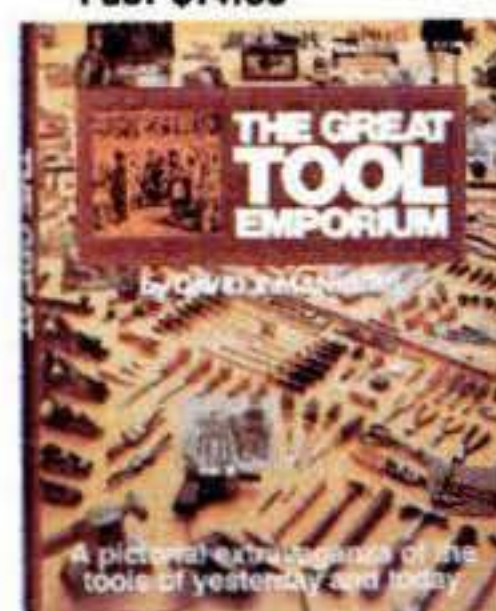
5512. Tune Up & Trouble-shooting. Pub: \$12.95



★056. How to Service & Repair Your Own Car.
Pub: \$14.95



★150. How to Repair, Reupholster & Refinish Furniture. Pub: \$13.95



★128. The Great Tool Emporium. Pub: \$16.95



2376. The Furniture Maker's Handbook. Pub: \$19.95

How Your Club Works

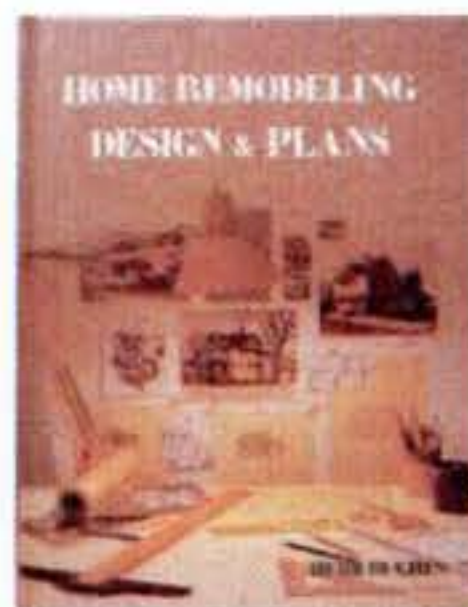
☐ First, you get your choice of any three do-it-yourself books shown here for just \$3.95, plus delivery and handling, along with your FREE 20-IN-ONE SHOP GUIDE. Simply mail the attached card. Your books will be sent right away. Send no money—we'll bill you after you receive your books.

☐ Then about every four weeks (13 times a year), you'll receive a Club bulletin describing the coming main selection and alternate books also available. If you want the main selection only, do nothing. It will be sent automatically. If you don't want the main selection, or want alternate books, or no books, simply indicate your wishes on the handy form that comes with the bulletin and return it to us by the date shown. Club mailings are carefully scheduled to assure you of at least 10 days in which to do this. But in the unlikely event that you don't have 10 days, and you receive an unwanted selection, you may return it at our expense.

☐ After receiving your joining shipment, your only obligation is to buy two more regular selections or alternates in the next year. After that, membership may be cancelled at any time, by either you or the Club.

☐ Club books are comparable in every way—paper, printing, binding, jacket—to original publishers' editions, yet you may save up to 50% and sometimes more on hundreds of special books offered each year in the Club. To become eligible for these bargains, mail the card today!

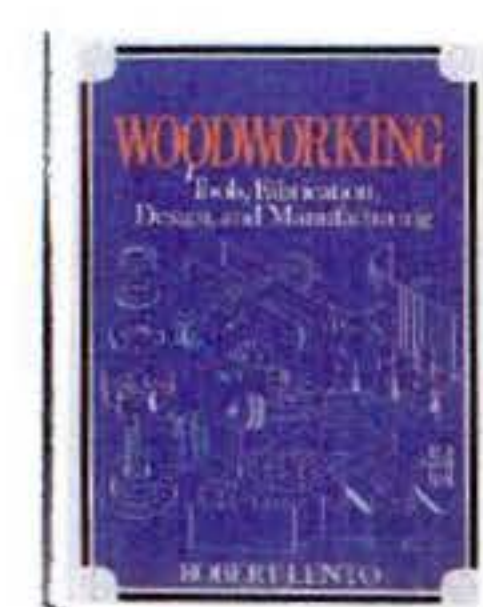
27 books
to choose from



5500. Home Remodeling Designs & Plans.
Pub: \$12.95



0281. Rattan Furniture.
Pub: \$12.95

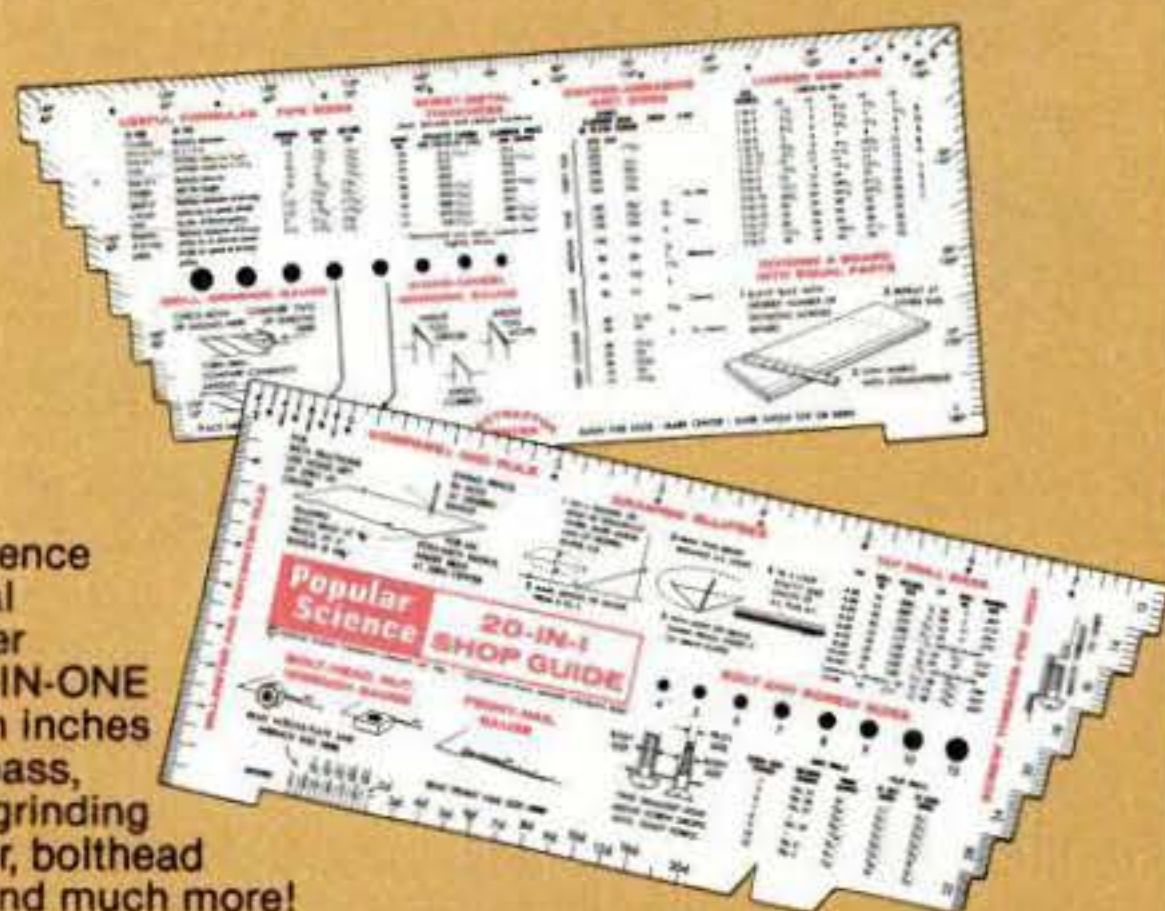


0258. Woodworking, Tools, Fabrication & Manufacturing.
Pub: \$21.95

This multiple Miracle Measurer YOURS FREE

When you join Popular Science Book Club with this special offer, you also get the super handy Popular Science 20-IN-ONE Shop Guide. It measures in inches or centimeters. It's a compass, protractor, drill and chisel grinding gauge, bolt and screw sizer, bolthead and penny nail measurer and much more!

POPULAR SCIENCE 20-IN-1 MEASURING TOOL
A practical FREE GIFT when you join Popular Science Book Club



Newport Lights



© Lorillard, U.S.A., 1981

Revive your taste!
Newport pleasure comes
to low-tar menthols



Softpack
and Box

Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health.

Box: 9 mg. "tar", 0.8 mg. nicotine av. per cigarette by FTC Method.
Kings: 9 mg. "tar", 0.8 mg. nicotine av. per cigarette, FTC Report Oct. 1980.

SCIENCE NEWSFRONT

By ARTHUR FISHER

Earth-resources aircraft

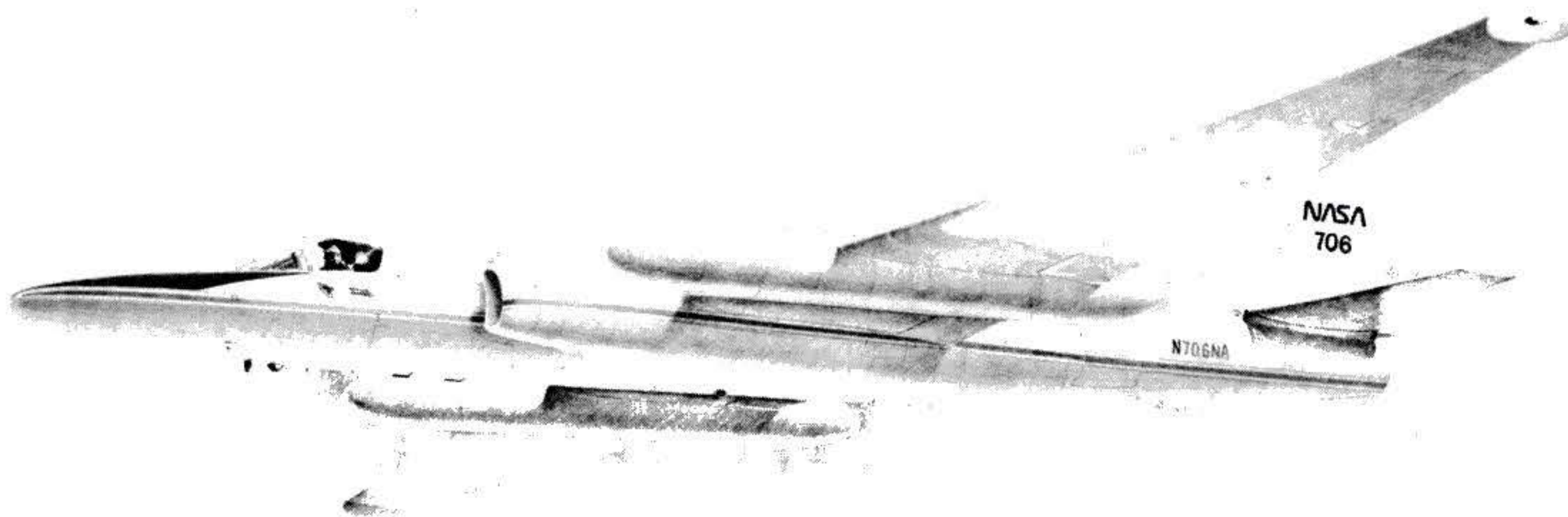
The sleek craft you see below in a drawing by NASA artist Roger Arno is a new high-altitude plane designed to augment the research program of Earth surveillance now being carried out by a pair of Lockheed U-2 aircraft. Called the NASA ER-2 (for Earth resources), it is a single-engine, single-place jet aircraft, like its sister ships. But it can fly higher and faster than the U-2's and carry triple the payload. It can lift nearly two tons of instruments

to just fall apart," says Russell, "but power-distribution systems in the United States are not meant to withstand widespread disturbances such as solar activity—or, say, nuclear blasts, which are scaled-down versions of solar flares."

Past solar flares, which resulted in torrents of charged particles and strong magnetic fields impinging on Earth's atmosphere, have tripped safety relays and circuit breakers all over the country and even caused power-line overloads that have blown open a transformer. "As new con-

be broken down by the action of microorganisms or other natural processes. Thus they accumulate in the environment and can, in effect, form a permanent, poisonous reservoir, posing both an ecological and health threat.

Now Dr. Donald T. Sawyer and Dr. Julian Roberts at the University of California report that superoxide, a form of the oxygen molecule that is negatively charged because it carries an extra electron, has a unique power: It can break the tenacious carbon-halogen bonds, which make the halogenated hydrocarbons so resistant to decay. But the process must take place in the absence of water. Dr. Sawyer envisions a simple pollution eradicator, "a black box larger than a breadbox and smaller than a refrigerator." When an electric current is passed through chemical wastes in a water-free solution, the dissolved oxygen acquires extra electrons to become superoxide, which converts the toxic wastes into innocuous substances such as carbonates.



more than 70,000 feet high at a speed of 480 miles an hour, with a range of more than 3,000 miles. Instruments will be carried in the plane's nose, in a section behind the pilot, and in its two oversized wingpods, called—unsurprisingly—superpods. Among the instruments for scientific experiments and data gathering the ER-2 can carry are: imaging radar scanners; large-format camera systems; stratospheric air samplers; devices for severe-storm detection; and other sensors for research in meteorology, astronomy, astrophysics, and Earth resources. The ER-2 is scheduled for delivery to NASA's Ames Research Center from its builder, the Lockheed California Company, in May 1981.

From the sun: power outages

This country's network of power-distribution systems is becoming increasingly vulnerable to violent events on the sun (see "The Sun's Violent Flares," this issue). That's the conclusion of Dr. Don Russell, a specialist in protecting power systems and director of the Electric Power Institute in Texas A&M's Electrical Engineering Department and Texas Engineering Experiment Station.

"The whole power system is not going

to just fall apart," says Russell, "but power-distribution systems in the United States are not meant to withstand widespread disturbances such as solar activity—or, say, nuclear blasts, which are scaled-down versions of solar flares."

The Electric Power Institute is working under a \$450,000 grant to explore ways of protecting electric-power networks from solar—or other—interference. "We use the same equipment employed by the Air Force at Kirtland Air Force Base for nuclear-blast studies," says Russell. But instead of studying electromagnetic pulses around missiles and aircraft, electrical engineers investigate power lines, transformer substations, and switching yards.

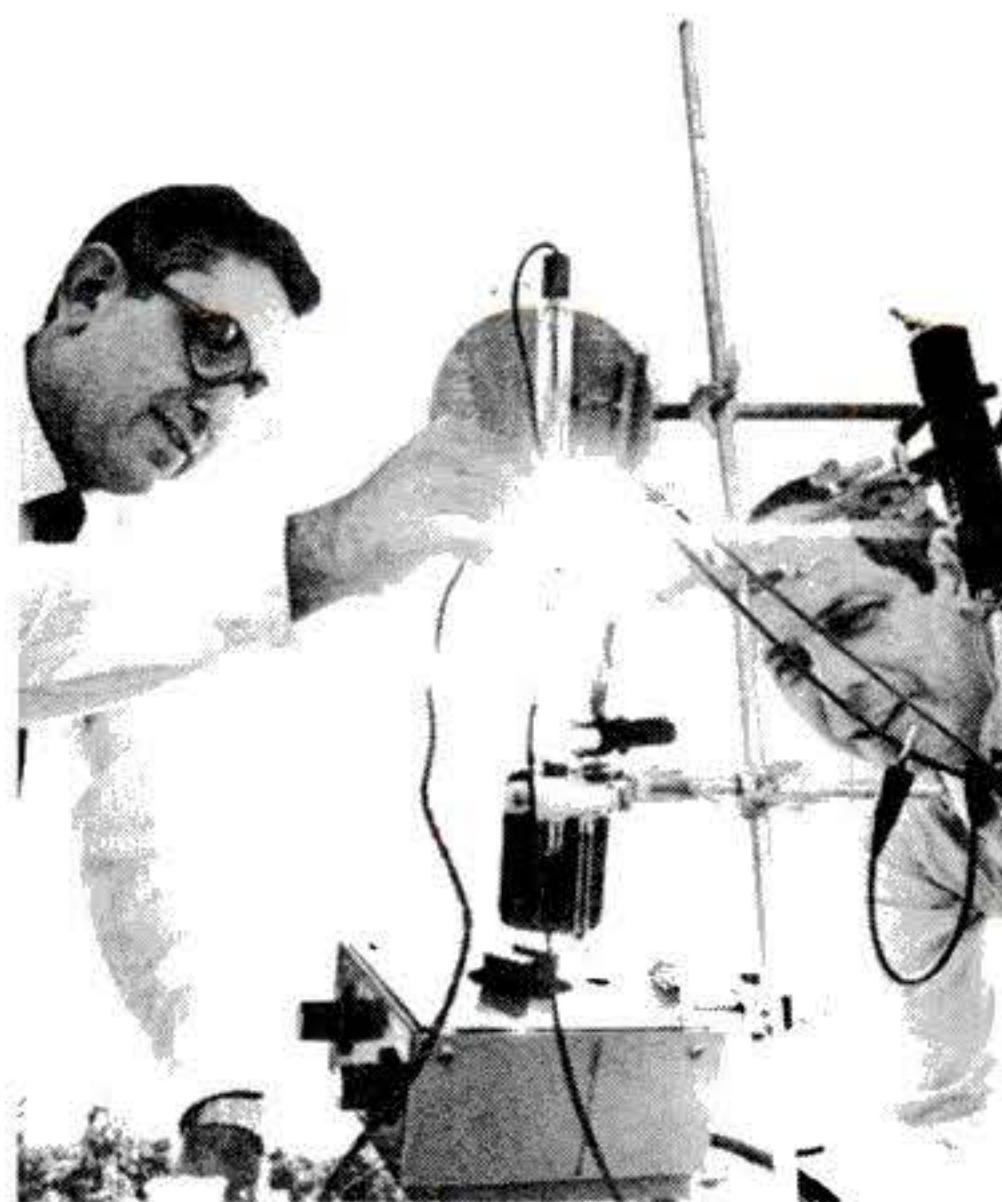
Superoxide fights toxic waste

Chemists at the University of California-Riverside have discovered that an unusual form of oxygen called superoxide has "an unpredictable, almost magical property" that can make it a potent weapon in the war against toxic chemical wastes. A large part of the hazardous-waste problem centers on a group of chemical compounds called halogenated hydrocarbons, which have become ubiquitous in the products we use daily—clothing, packaging, and some plastics, for example. The trouble is that many of these toxic chemicals cannot

The University of California research has been supported by the National Science Foundation.

Solar-cell advance

Bell Labs researchers Adam Heller (at left in photo below) and Barry Miller demon-



Continued

Science newsfront

[Continued]



strate a new liquid-junction solar cell. According to Heller, who heads the Electronic Materials Research Applications Department at Bell Labs in Murray Hill, N.J., the experimental device "appears to be a significant advance."

All solar cells produce the photovoltaic effect at the junction of two materials, traditionally two semiconductors. In a liquid-junction cell, two electrodes (one a semiconductor) are immersed in a solution, an approach that may eventually lead to longer-lived, more economical cells than solid ones. The new Bell Labs cell converts sunshine to electricity with an efficiency of 11.5 percent, comparable to commercially available single-crystal solar cells. Most importantly, it overcomes a serious problem with previous liquid-junction cells, which tended to break down the longer they were exposed to light. The new cell, on the contrary, becomes more stable the longer it is exposed to intense light.

Measuring pollution with DIAL

A new instrument that can perform the previously impossible task of measuring air pollutants in three dimensions over wide areas has been developed by SRI International of Menlo Park, Calif. In the photo below, researcher James Hawley adjusts the device, called DIAL (for differential absorption lidar). Mounted in a truck trailer, it sweeps two beams of ultraviolet laser light across a plume of emissions from a stack and measures the concentrations of gases present.

Lidar itself stands for light direction and ranging. Where radar emits pulses of radio waves and detects their return echo, lidar sends out pulses of laser light and measures the energy reflected. The DIAL system can survey an area stretching up

to two miles from a source of pollution to determine where the pollutants actually touch the ground. It has been difficult until now to tell how plumes of such gases as sulfur and nitrogen dioxides disperse after they have left the tall stacks of power plants, an important variable if limits on air pollution are to be met.

Hybrid Dragonfly

An ultra-fuel-efficient hybrid propulsion system is concealed beneath the snazzy lines of this prototype two-seater, the Dragonfly Nova (photo above). Its British designer claims a fuel economy of up to 85 mpg, with a cruising speed of 55 mph and a maximum speed of 80 mph. The secret is a gasoline-electric power pack that keeps a Fiat 600-cc two-cylinder engine running at constant speed for peak thermal efficiency while charging eight ordinary 12-volt car batteries. These power an unusual double-armature 20-kilowatt disc motor driving the rear wheels. The motor has twin rotors with independent output shafts for the two wheels. Thus it acts as a differential to save the weight and cost of the usual geared axle or of two separate motors. Encapsulated construction with permanent ferrite magnets cuts weight further and boosts electrical efficiency. In city driving the engine can be shut down to reduce noise and pollution. The batteries alone can then provide a 15-mile driving range.

Expanding the universe

The limits of the observable universe have been pushed outward by astronomers who report the existence of giant galaxies 10 billion light-years away from Earth. The farthest galaxies ever observed previously were reported six years ago at a distance of about eight billion light-years. Hyron Spinrad of the University of California in Berkeley and colleagues there and at Kitt Peak National Observatory, in Arizona, have located the galaxies and measured some of their properties by analyzing their light. The galaxies display the largest red shifts—greater than one—ever observed ["Fate of the Universe," PS, Dec. '80]. The discovery adds credence to a cosmological time scale that puts the age of the universe at 18 billion years. **PS**



MUSKOL™ 100% CONCENTRATE

Provides up to 10 hours effective protection against mosquitoes, black flies, chiggers, ticks & gnats.

MUSKOL contains 100% DEET (the ingredient proven most effective in repelling mosquitoes, black flies, chiggers, ticks & gnats.) Compare MUSKOL'S percentage of DEET to the brand you're now using. (Muskol is Far Superior in Repelling Mosquitoes, Chiggers & Ticks — Doug Knights Column, Sports Afield, July 1975).

■ **Now Available in the U.S.A.**

■ **Over 20 Years in Canada.**

MUSKOL has been a success in Canada for years because it REALLY WORKS against mosquitoes, black flies, chiggers, ticks & gnats. Now this super repellent is available in the U.S.A.

■ **No Sticky Feeling.**

■ **Practically No Scent.**

■ **Easy to Apply.**

Liquid Muskol is easy to apply. There's no pill to take internally, no wasteful limited protection aerosol, no messy aromatic cream.

■ **Muskol Costs Less.**

Because of its 100% concentrate Muskol goes much further than other repellents, so in the long run Muskol costs less.

"Don't Get BITTEN Again! Before You Buy, Read the Label. Buy MUSKOL!"

Available in 1 oz. and 2 oz. sizes.

Ask your retailer for Muskol or write

MUSKOL U.S. Ltd.
P.O. Box 644 Truro, N.S.
Canada B2N 5E5

DEALER INQUIRIES INVITED



STOP BURGLARS BEFORE they enter your home

Protect your family with this
new micro-computer burglar alarm
"FREE" for 30 days.

Burglars seek easy targets. Few have the daring or the knowledge to challenge the new Perim-A-Tron™ Home Security System. No other burglar alarm under \$2,000 can give you more protection...or match it for features that will give you and your family safety and peace of mind. For starters, it is wireless, installs in minutes, and is portable should you ever move.

THE BRAIN VS. THE BURGLAR

Perim-A-Tron's™ central console, or "BRAIN", employs a microprocessor, making it the **most advanced security system available for consumer use**. With Perim-A-Tron™ on duty, small sensors monitor doors and windows ready to signal the "Brain" from as far as 250 feet, in the event of a break-in attempt. The "Brain" processes each signal instantaneously and sounds not only a self-contained 85db internal alarm, but also a second 95db remote siren to augment the inside alarm or for placement outside to alert neighbors and police.

The Perim-A-Tron™ is so easy to live with that pets can come and go through partly-open windows or sliding glass doors without triggering it, yet so vigilant that an intruder will set it off before he can enter.

THOUSANDS OF OPTIONS

Perim-A-Tron's™ micro-computer lets you choose from thousands of three digit disarm codes. **Only you know your code**. But if your son's friend receives a "demonstration", you can easily change the code again...and again. You need no specially coded key which can be lost, misplaced, or stolen. The system even has two separate channels, each with its own distinct alarm sound. This feature allows you to zone your system. For example: Channel 1—house, Channel 2—garage, or Channel 1—doors, Channel 2—windows.

HOW IT WORKS

Operating the system is simplicity itself. When leaving, a light on the console tells you that you've armed the system properly, and have from 5 to 45 seconds to leave the house. This variable delay feature, not found on some expensive commercial systems, is selective so that it can apply only to frequently used doors. All other openings would be set for instant alarm. Upon returning home, you have ample time to turn the system off, thereby avoiding a false alarm.

If a break-in attempt occurs while you're away, an alarm memory light on the console tells you so. What's more, after sounding for



Perim-A-Tron's™ 20 button keyboard gives you protection a \$2,000 commercially installed system can't beat. Includes powerful remote horn.

10 minutes and scaring away the intruder, the system shuts off automatically and re-sets itself.

A CONSTANT GUARDIAN

Leave Perim-A-Tron™ in Test Mode during the day and it will signal when anyone leaves or enters. This thoughtful signal will not operate the remote horn but gives a 2½ second warning on the internal speaker only.

If power fails (or is cut-off), the console has a battery back-up. And each battery powered transmitter/sensor will signal at the console if the battery runs low.

The Perim-A-Tron™ system is **highly resistant to false alarms because it is not sensitive to motion or sound**. Pets can roam at will, curtains can blow in a breeze, you or your children can visit the kitchen for a midnight snack—all without setting off an alarm.

COMING HOME SAFELY

There is nothing more frightening than finding a prowler lurking near your house when you arrive home at night. Our system's **EXTRA PROTECTION DESIGN** lets you carry a transmitter in your pocket, purse or glove compartment (it's about the size of a cigarette pack). With simple modification, it serves as a PANIC device and will set off the alarm at the press of a button.

COMPARE IT

Hard-wired "commercial" burglar alarms can cost \$2,000 PLUS a monthly fee (and you still never own it). Motion and sound detectors cost up to \$200 per unit and cover only limited areas. Your home may require two or three of these units and, in most cases, no alarm will sound until AFTER a prowler is inside for 30 seconds or more. Perim-A-Tron™ combines **pre-entry** protection with micro-electronic circuitry to provide the most protection at the lowest cost.

U.L. APPROVED

The Perim-A-Tron™ Home Security System is listed by Underwriters Laboratories as a **burglary protection device**, a rating which goes beyond electrical safety. To earn this listing our alarm was thoroughly tested for critical burglary protection functions such as transmitter range, sound volume, battery back-up, keyboard component life, battery failure warning, and test function. This tough-to-get U.L. listing resulted from the exacting standards engineered into the Perim-A-Tron™.

YOU BE THE JUDGE

We urge you to order just the basic Perim-A-Tron™ system (pictured above) for a 30-day trial period. Use it to protect your family while you sleep and to protect your home while you're away. Then if you're not convinced that the Perim-A-Tron™ is the most advanced, efficient security system available today, return it undamaged for a complete, no-quibble refund—including return postage. You are protected by a 90 day manufacturer's warranty as well as Shelburne's 25 year reputation for satisfied customers.

HERE'S HOW TO ORDER

To order simply send your check for **\$199.95** plus \$4.50 for shipping and handling to the address below. Credit card holders can speed delivery of their system by using our toll-free number listed below. We will then promptly ship your Perim-A-Tron™ unit complete with easy-to-understand instructions and decals warning that the premises are protected. Additional transmitters are available for \$29.95 each, but one is not required for every door and window. Instead, magnetic contacts can be purchased and easily connected to the transmitter, allowing you to cover additional openings for as little as \$5 each. The instruction booklet is quite useful in helping you determine the correct combinations to protect your home or office at the lowest possible cost.

Give yourself some peace of mind—order a Perim-A-Tron™ today at no obligation.

Maryland Residents add 5% Sales Tax.

CREDIT CARD HOLDERS

CALL TOLL-FREE:

800-638-6170

from 9am-5pm EST Mon.-Fri.

Maryland Residents Call 363-4304

©1981 The Shelburne Company

The
Shelburne
Company

110 Painters Mill Road Dept. V-35
Owings Mills, Md 21117 (301) 363-4304

This photo shows a transmitter & magnet installed. If a break-in attempt occurs, separating the two, the transmitter sends a signal to the console which sounds an alarm to scare away the burglar. Installation takes only a few moments & doesn't even require a screwdriver.





GMC is
a division of
General
Motors.



We're known for having a lot of pull.

In fact, our giant GMC Generals, Brigadiers and Astros pull some very hefty loads on the highway.

And the same name that's on our heavy-duty trucks is on our light-duty models. Something to think about when you're buying a vehicle to haul your trailer, boat or whatever you have to tow.

Like our $\frac{3}{4}$ -ton Wideside Pickup, for instance. It can be

equipped to pull a 10,000-pound trailer. And for even greater towing capacity, GMC offers a dual-wheeled, one-ton pickup. Then, for people-carrying plus load-towing,

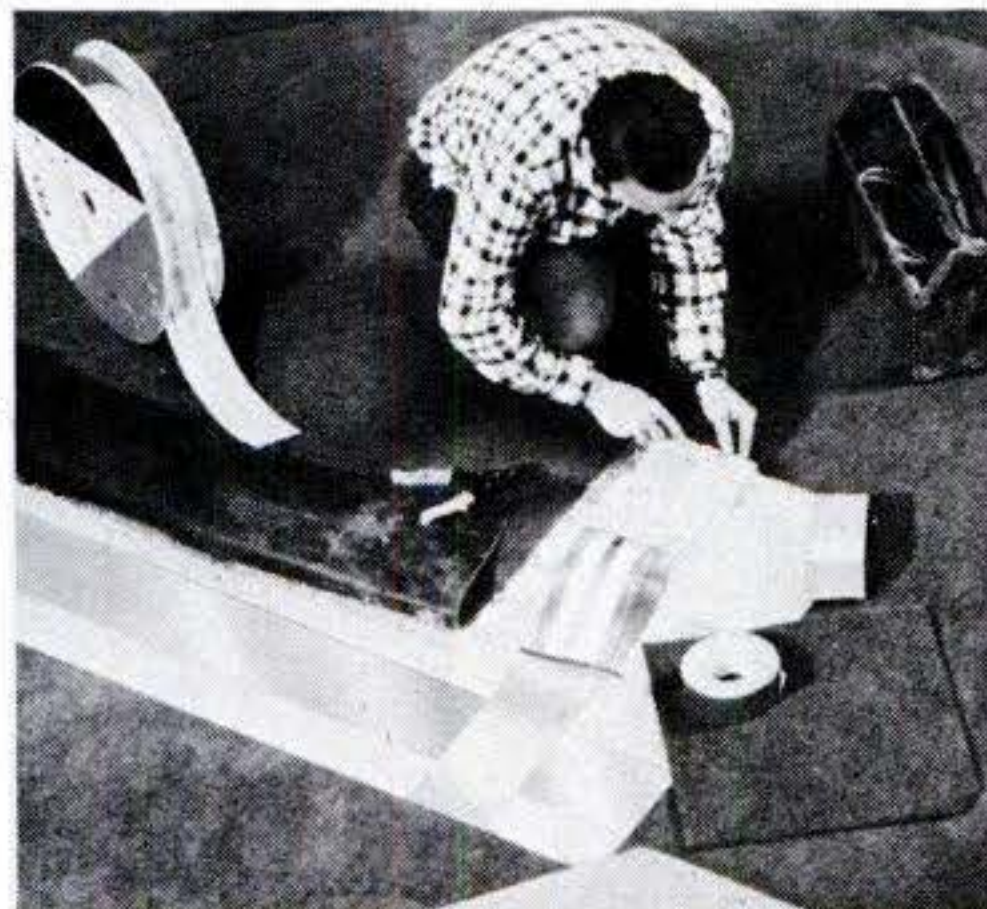


there are GMC's handsome, hardy Suburbans and vans.

You'll be happy to know that all GMCs are covered by a Three-year Perforation from Corrosion Limited Warranty. Exhaust system components are not included. Ask your GMC dealer for details on other limitations. And ask him about buying or leasing a truck with a lot of pull. A GMC.

TRUCKS ARE WHAT WE'RE ALL ABOUT.

Flat wiring is 0.035 inch thick



I was standing on it while it powered a video monitor, lights, and a microphone—and I didn't know it. Our demonstrator lifted a carpet tile, revealing a glossy steel strip. It was flat wiring in action.

Versa Trak, the first version of flat wiring [PS, June '75] to be approved by UL and the National Electrical Code, was developed by Thomas & Betts of New Jersey. Other companies, such as Parlex of Connecticut and AMP of Pennsylvania, are also entering the market.

The system is approved for use under carpet squares only. But it's easy and cheap to install: \$70 to rewire a set of outlets, compared with \$250 for conventional round wire.

At first glance the wire seems rather less compact than you'd expect. It's about 3½ inches wide. But it's the flatness that counts. The wire is constructed in layers. On top and bottom are sheets of protective material, including the steel tape I saw at the demonstration. At the core, conductors in the form of 0.9-inch-wide strips are sandwiched between two layers of polyester film and spaced 3/16 inch apart.

Slight perforations in the laminate between conductors make it easy to separate them for joining to round wire. Special connectors then bridge the gap between the two systems. The wire carries a 120-volt AC current and is rated at 20 or 30 amps.

Power is tapped by attaching one strip of wire to another in a T shape. To change its direction, you merely fold the wire.

But the real advantage of flat wire is that it can be just laid on the floor. The technique eliminates breaking into walls or floors and does away with metal conduits, all necessary with round wire.—Kathleen Brown



Sophisticated Personalized Computers.

Ohio Scientific has been building personal microcomputers since the industry began in 1975, far longer than current self-proclaimed industry leaders.

Instead of offering one or two models of personal computers that are supposed to handle all possible applications, Ohio Scientific offers 14 models ranging in price from \$299 to over \$20,000. The company offers different models optimized for education, small business, product development, the home experimenter, professionals, and casually interested beginners. Each model offers state-of-the-art performance and unique features and capability for its cost and range of applications.

Ohio Scientific products are sold and supported by over 400 dealers worldwide. **For literature and the name of your local dealer, CALL 1-800-321-6850 TOLL FREE.**

OHIO SCIENTIFIC

1333 SOUTH CHILLICOTHE ROAD
AURORA, OH 44202 • (216) 831-5600

Meet the home of the future today!

Now you can build 2,500 square feet of living space and actually *cut* monthly heating/cooling costs by up to 50 percent! Introducing the Cathedralite geodesic home.

One- and two-story homes are now available. Our quality crafted, pre-assembled panels make construction of a Cathedralite geodesic shell possible in just eight hours! And if you'd like to expand your home in a few years, add-ons and room extensions are also available.

For the complete story from the world's largest manufacturer of wood geodesic structures, send \$5 with the coupon below. We'll rush you our 42-page, full-color, mail-order catalog, plus our 12-page plans book containing 50 different floor plans! Just fill out and mail today to: **CATHEDRALITE**, 820 Bay Avenue, Capitola, California 95010 (408) 462-2210.

For \$5 we'll show you how!

☐ **YES!** Enclosed is \$5. Please rush me my 42-page, full-color catalog and my 12-page floor plans book!

Name _____ P61

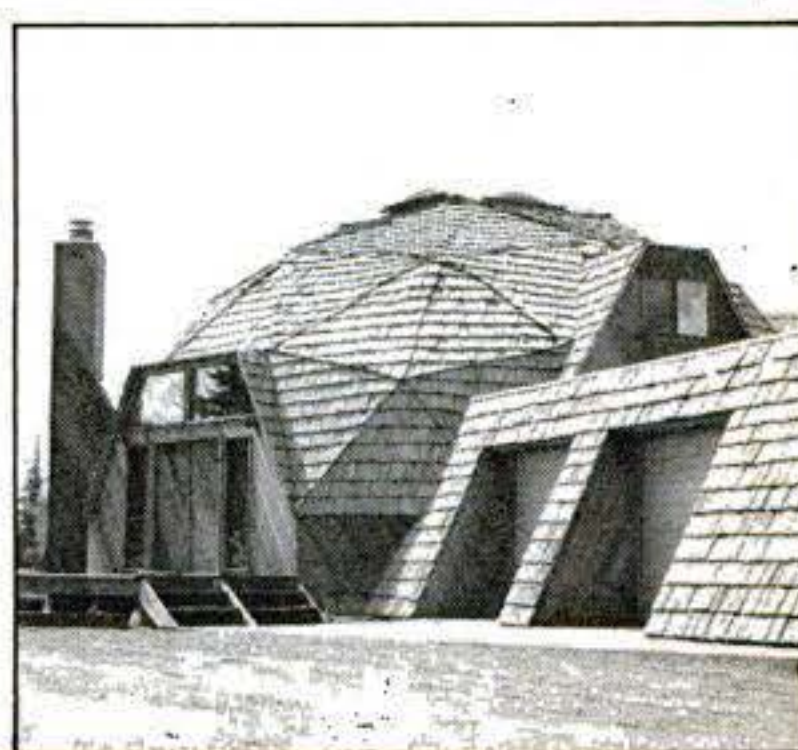
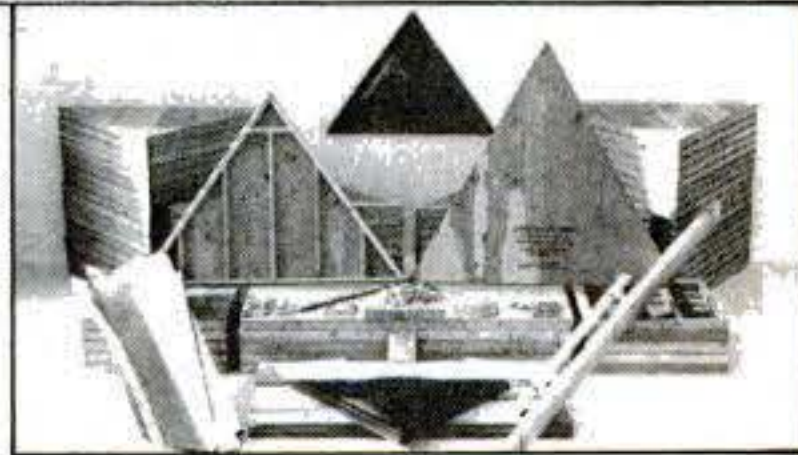
Address _____

City _____ State _____

Zip _____ Phone _____

CATHEDRALITE

820 Bay Avenue, Capitola, California 95010 (408) 462-2210



Mid-size coupes

—plusher, lighter, trimmer

By **JIM DUNNE** and **ED JACOBS**
PHOTOS BY JOHN KEATING

Like everything else around them, personal-luxury coupes are undergoing massive changes. Their once-ponderous, ocean-liner-like proportions are disappearing in favor of lighter, trimmer, more aerodynamic designs. Styling flair, comfort, and luxury are still there, but what about other aspects?

To find out, we selected four representative models: Chevrolet Monte Carlo, Chrysler Cordoba, Ford Thunderbird, and Oldsmobile Cutlass Supreme.

They were powered by a variety of engines: an in-line six for Thunderbird, a turbocharged V6 for Monte Carlo, gasoline V8 for Cordoba, and a diesel V8 for Cutlass. Three V-type gasoline engines were originally selected to give roughly similar performances in their respective cars. The diesel was included to show the trade-offs when it's installed in a sister GM car. (Cutlass Supreme and Monte Carlo share GM's A-special body with Pontiac Grand Prix and Buick Regal.)

PS ratings— test report in a nutshell

The ratings are based on test results and measurements. Results should be read with the understanding that they reflect tests only on our sample cars. An excellent rating is 5 points; very good, 4; good, 3; fair, 2; poor, 1; very poor, 0.

	Chevrolet Monte Carlo	Chrysler Cordoba	Ford Thunderbird	Oldsmobile Cutlass diesel
Acceleration	5	5	0	0
Braking	2	2	1	1
Handling	4	5	3	2
Maneuverability	5	5	4	4
Quietness	2	3	2	2
Roominess	4	4	4	4
Vision	3	2	2	2
Entry/exit ease	4	3	4	4
EPA economy	3	2	3	4
Ride comfort*	4	4	2	4

*Authors' opinion

Unfortunately, Ford was unable to supply the 255-cu.-in. V8 we ordered, so we got a less-than-direct comparison with the Thunderbird.

Even so, there were some surprises. Not only did the biggest, heaviest car turn in the best all-around performance, it also had the best gasoline economy. Conversely, the lightest, newest design turned in the poorest all-around performance and economy. Equally surprising was that the

Continued



Oldsmobile Cutlass Supreme diesel, Chevrolet Monte Carlo, Ford Thunderbird, and Chrysler Cordoba (clockwise from upper left).

MUST LIQUIDATE AT BELOW DEALER COST!

3-Speed, Horizontal & Vertical 3/4 hp. 6" BAND SAW

Heavy-Duty for Steel, Iron, Copper, Wood, Plastic, etc.

CUTS STEEL UP TO 4 1/2" ROUND, UP TO 4" x 5 1/2" RECTANGULAR!

Here's a big, rugged, heavyweight band saw with plenty of power to slice through steel up to 5 1/2" thick! It saws easily through any shape stock — flat, bar, square, channel, tube. Use it to saw lumber, plastic, copper, brass, aluminum, iron, with proper saw blade. Comes with standard 1/2" blade, 64 1/2" long. Blade rides on big 7 1/2" bandwheel.

For horizontal cuts, you can vise-lock work in position and walk away. Automatic shut-off turns off machine when cut is completed. Tension control spring adjusts quickly to feed blade at proper rate of speed for smoothest cutting. It cuts in vertical position, too, so you can slit, notch or cut contour shapes! An ideal cutting tool for your workshop!

- 1 Cuts up to 4 1/2" round stock; up to 4" x 5 1/2" rectangular stock.
- 2 3/4 hp. capacitor start motor gives plenty of power. Three-prong plug fits 110V outlet.
- 3 Steel and bronze gears; worm gear drive for smooth, long-lasting performance.
- 4 Easy adjustment for blade tension.
- 5 Adjustable roller guides; ball bearing thrust guide to keep blade rigid for most effective cutting. Prevents loose blades that break.
- 6 Heavy duty stand for firm, sturdy support.
- 7 Heavily ribbed cast iron saw bow provides mass weight and rigidity plus reinforcement.
- 8 Heavy duty metal work stop lets you repeat same length cut, time after time.
- 9 Head support allows quick work change without lifting saw head all the way up.
- 10 Equipped with NEMA 56 motor frame.
- 11 Easy access for change of blade.

\$470.00 value
OUT THEY GO AT ONLY:

\$198

Includes complete operating manual.

Set of Wheels & Drawer, \$25 Extra
Set includes handy drawer for holding tools; wheel kit for easy movement of band saw. Ideal accessories . . . only \$25.00 extra.



Credit card customers can phone orders:



Toll-Free: 800-328-5082

If busy signal, or after business hours, or if in Minnesota, call **800-228-2606** 24 hours a day, 7 days a week.

C.O.M.B. Co.

ONE OF THE NATION'S LARGEST AUTHORIZED MAIL ORDER LIQUIDATORS OF CONSUMER PRODUCTS
3258 MINNEHAHA / MINNEAPOLIS, MN 55406

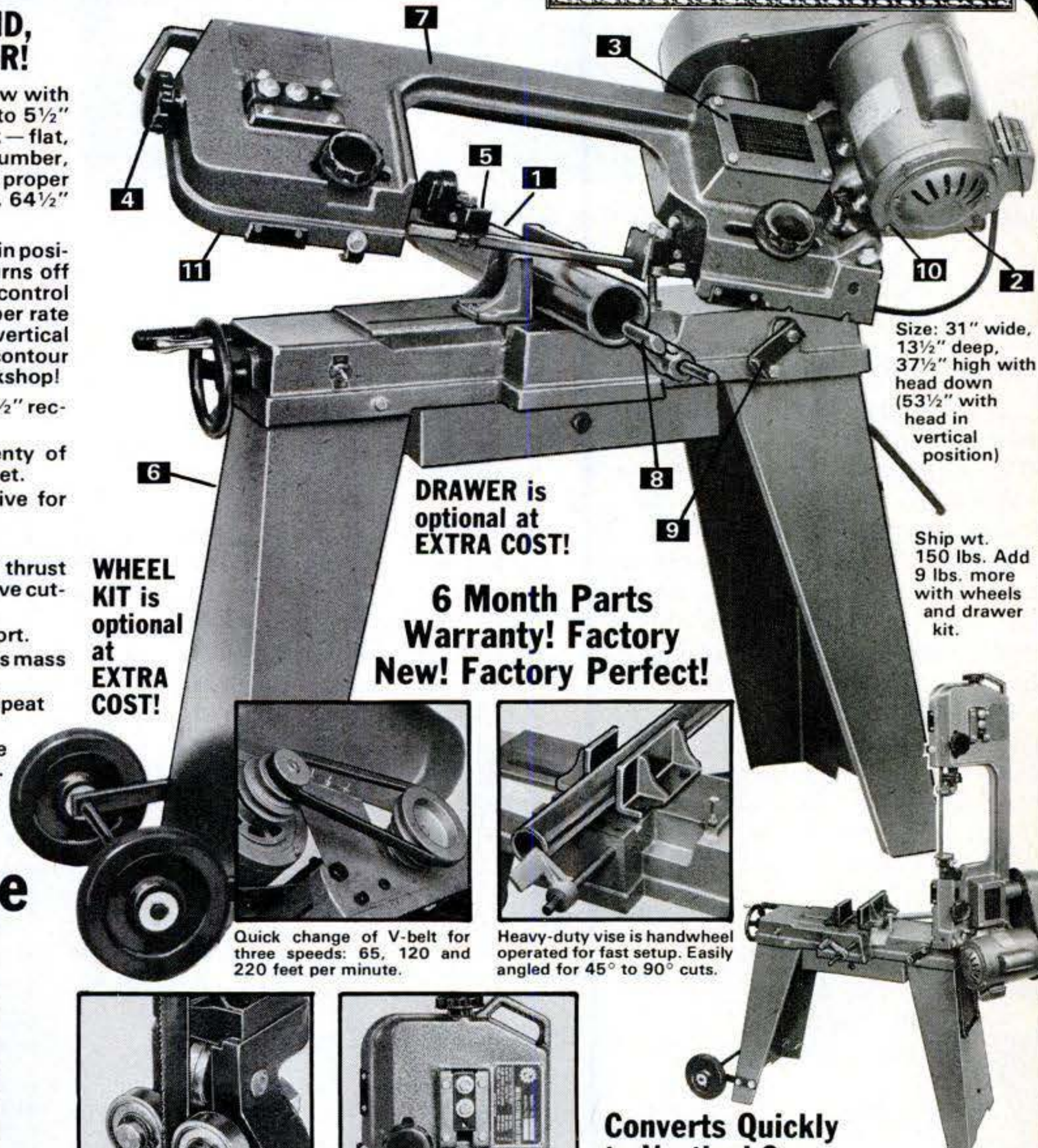
PUBLIC NOTICE!

Bankruptcy and Financially Distressed Merchandise!

We are authorized liquidators of inventories that must be quickly sold at sacrifice prices because of a variety of reasons such as:

Overproduction . . . last year's models . . . economic recession . . . bankruptcy . . . plant closings . . . order cancellations . . . financial problems . . . discontinued lines, etc.

If you know of any company that has surplus inventories that must be liquidated for immediate cash, call us Toll-Free: 800-328-5082. Only products in perfect operating condition will be considered.



Size: 31" wide, 13 1/2" deep, 37 1/2" high with head down (53 1/2" with head in vertical position)

Ship wt. 150 lbs. Add 9 lbs. more with wheels and drawer kit.

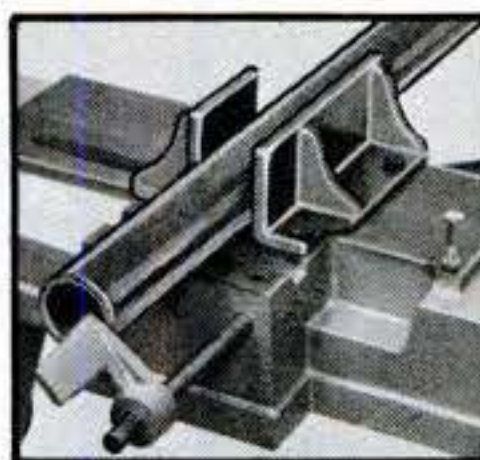
DRAWER is optional at EXTRA COST!

6 Month Parts Warranty! Factory New! Factory Perfect!

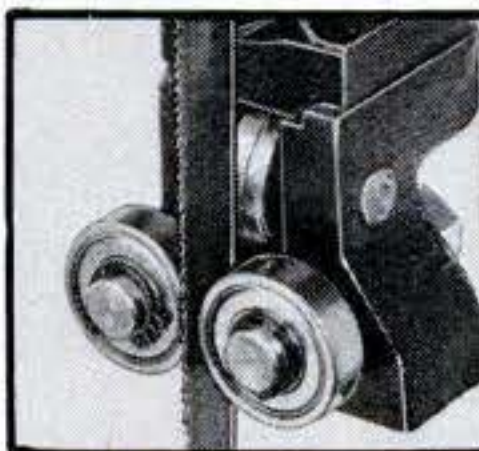
WHEEL KIT is optional at EXTRA COST!



Quick change of V-belt for three speeds: 65, 120 and 220 feet per minute.



Heavy-duty vise is handwheel operated for fast setup. Easily angled for 45° to 90° cuts.



Blade guide arm adjusts for size of work; gives maximum rigidity to blade for squareness and accuracy.



Idler bandwheel mounted on gibbs for alignment adjustment, accuracy and proper blade travel.

Converts Quickly to Vertical Saw With a Handy Cutting Shelf!

The saw head tilts back for use as a vertical saw! A handy cutting table is included. You can notch, slit or cut contour shapes using the shelf for support. It's like having two saws in one!

C.O.M.B. Co. / Authorized Liquidators

Dept. B-514-1040

3258 Minnehaha Avenue S., Minneapolis, Minn. 55406

Send me _____ Heavy Duty Band Saw(s) at \$198.00 each. I will pay shipping charges to the driver upon delivery. (Allow 4-5 weeks for delivery. If paid by personal check, add an extra 2 weeks. Sorry, no C.O.D. orders.)

Also send _____ sets of Wheels & Drawers at \$25 per complete set (includes shipping).

☐ My check or money order is enclosed.

Charge to my: ☐ Mastercharge ☐ VISA ☐ American Express

Acct. No. _____ Expires _____

PLEASE PRINT CLEARLY

Name _____

Address _____

City _____

State _____

ZIP _____

Phone _____

Rural Route Customer: If truck carriers do not normally deliver to your home, include a note with this order, stating nearest town address of store, friend, truck terminal where we can ship.

Minnesota residents add 4% state sales tax.

Copyrighted material



Cutlass Supreme's hydraulically boosted brakes locked all four wheels too easily.

top-economy diesel wasn't the slowest car in the group.

Monte Carlo

Like the other GM A-special bodies, Monte Carlo has been "reskinned" for 1981, which means that a fresh, new exterior was put on the old chassis. Primary emphasis was placed on good aerodynamics. The bumpers blend smoothly into the fenders, and the rear quarter windows are mounted nearly flush with the sheet metal to eliminate drag-inducing air pockets. A sloping hood and a raised trunk improve overall airflow.

Our test Monte Carlo's most important feature was its Buick-built 3.8-liter (231 cu. in.) turbocharged V6 engine. It's intended to give six-cylin-

der economy when cruising and V8-like power when needed. We found that it could match the V8-powered Cordoba's zero-to-60-mph acceleration time and still deliver good fuel economy. If you use the turbocharger frequently, however, economy plummets.

The power builds unobtrusively, and since Monte Carlo lacks a boost gauge, you may inadvertently use the boost when you don't need it. A moderately attentive ear will detect the turbo's siren-like whine, though, and you just ease up on the accelerator a bit to cut the turbo out. One drawback to this engine is its 3,000-mile oil-change interval, necessary to cope with the turbo's high temperatures and 100,000-rpm operating speed.



Cordoba breezed through the slalom for a top mark in maneuverability (above). It also achieved the lone top rating in the high-speed handling (lane change) test.

Overall, our Monte Carlo was attractive and plush, with comfortable seating and a very good driving position. The car did very well in all of our performance testing except for braking: it turned in an extremely long (230-ft.) panic stop with cold brakes.

Cordoba

The chassis platform that Cordoba shares with its Dodge twin, Mirada, is also the base for Chrysler's ultra-luxury Imperial. It shouldn't be too surprising, then, that our Cordoba approached Imperial's sumptuous appointments. It was loaded with such items as crushed-velour upholstery, extensive wood-grain trim, and an electronic radio.

Cordoba's big-car ancestry also shows up in ways the interior dimensions don't suggest. There's more usable foot room, for instance, due to smaller transmission and drive-shaft tunnels. That makes moving around up front easier.

Chrysler's 5.2-liter (318 cu. in.) V8 is a well proved design. It provided both the best combined acceleration and—surprisingly—the best fuel economy among the gasoline-powered engines, despite Cordoba's less-than-svelte 3,500-lb. curb weight. The V8 also contributed to making Cordoba five decibels quieter inside at 60 mph. That's a significant difference.

The Cordoba's electronic emissions control made the engine speed up and slow down at times while idling, but that wasn't annoying. Although our car's engine stalled once or twice when cold, it performed well otherwise.

Recessed, low-set gauges are typical of larger Chrysler products and are hard for some people to read. Checking the shift-selector position, for instance, can be difficult.

Because of its optional (\$240) handling package, our Cordoba was the only car to get top marks in both handling and maneuverability. We think it should be standard equipment.

Thunderbird

Ford has moved quickly to correct an instrument-panel problem we pointed out last year: excessive reflection on its flat, glassy surface. This year, blackout finishes on the steering column, turn-signal stalk, and shift lever have substantially reduced the problem. But if you wear light-colored clothing, there will still be reflection, which can make the fuel gauge and some other instruments difficult to read.

The optional (\$376) Recaro seats are

Continued

Legends...Reborn



GAZELLE



CLASSIC SPEEDSTER



VINTAGE VAN



CUSTOM BUGATTI (WHITE)



35B BUGATTI (RED)



VINTAGE ROLLS

Classic Motor Carriages, the world's largest replicar assembly manufacturer, presents its classic line for the 80's. Millions of dollars have been spent in engineering research to enable Classic Motor Carriages to produce the finest replicar assemblies available. Gelcoat finish...no rusting ever! All replicar assemblies are fully warranted by a company that cares.

Classic owners report gas mileage of 30-34 M.P.G. Our replicar assemblies are designed for the person of average mechanical skills using ordinary tools. Complete the coupon to begin the most rewarding experience of your life.

Classic Motor Carriages, Inc.

PS6

16650 NW 27th Ave., Miami, Florida 33054 Telex: Replicar Opal 808244
(305) 456-1500 Sales • (305) 625-9700 Manufacturing & Leasing

Enclosed is \$3.00 for the full color brochure, consumer buying guide and all pertinent information on:

☐ Gazelle and Bugatti ☐ Classic Speedster ☐ Vintage Automobiles

For even more information, send for our detailed project guides which describe the process of constructing each of our replicar assemblies.

Enclosed is \$20.00 for: ☐ VW Gazelle ☐ Ford Gazelle ☐ Classic Speedster

☐ Custom Bugatti ☐ Bugatti 35B

☐ Enclosed is \$10.00 for the full color brochure and all pertinent information on the factory finished, handcrafted Gazelle.

Name

Address

City State Zip

Phone: (Bus.) (Res.)

Area Code

Area Code

Please charge ☐ Master Card ☐ VISA ☐ American Express

Acct. No.

Expir. Date Sig.

See our classic replicars on display at the following airports:

Amarillo, Burbank, Chicago, Cleveland, Dallas-Love, Dallas/Ft. Worth, Denver, Detroit, Jacksonville, Kennedy, LaGuardia, Miami, Minn./St. Paul, Monterey, New Orleans, Portland, Sacramento, San Antonio, San Jose, Seattle, St. Louis, Tucson, Dunes Hotel...Las Vegas, Caesars Palace...Atlantic City.

©CMC-81

**"Bring me your
energy problem.
I'll handle it
with Carrier."**



**HANDLE
WITH
CARRIER**

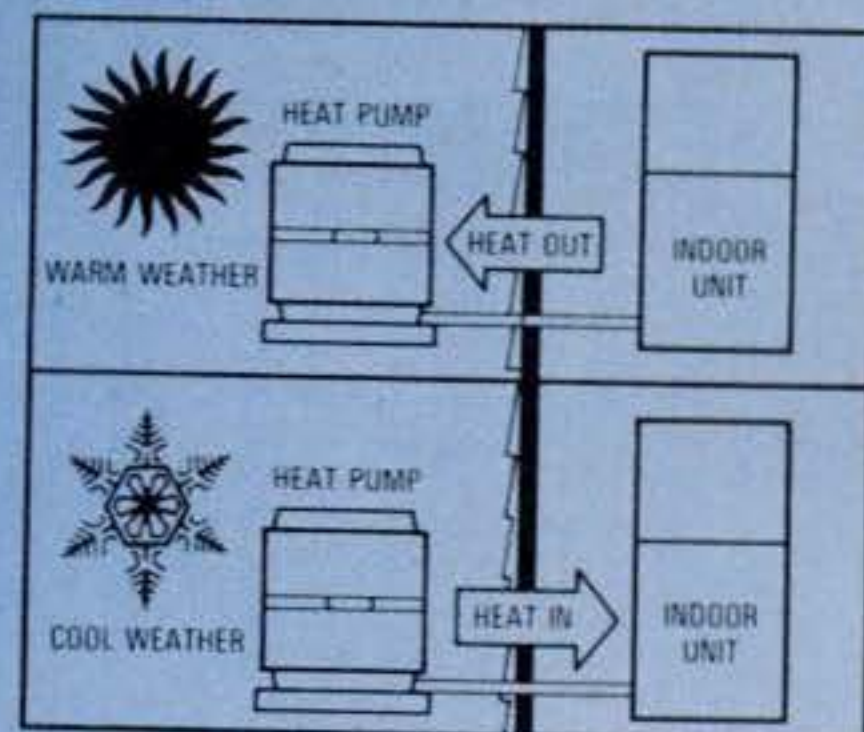


"As a Carrier dealer, I have to live up to my reputation as a heating and cooling expert. So you can rely on me to pay special attention to your energy and comfort needs."

"Whether you're adding a unit to your home, or replacing one, I'll handle it with Carrier. I'm trained to select the unit that will save you the most money."

"Like the Year-round One. A high-efficiency heat pump air conditioner. It cools, heats and saves you money all year round. And operates like this:

"IN HOT WEATHER, the heat pump functions as an air conditioner to give you economical comfort."



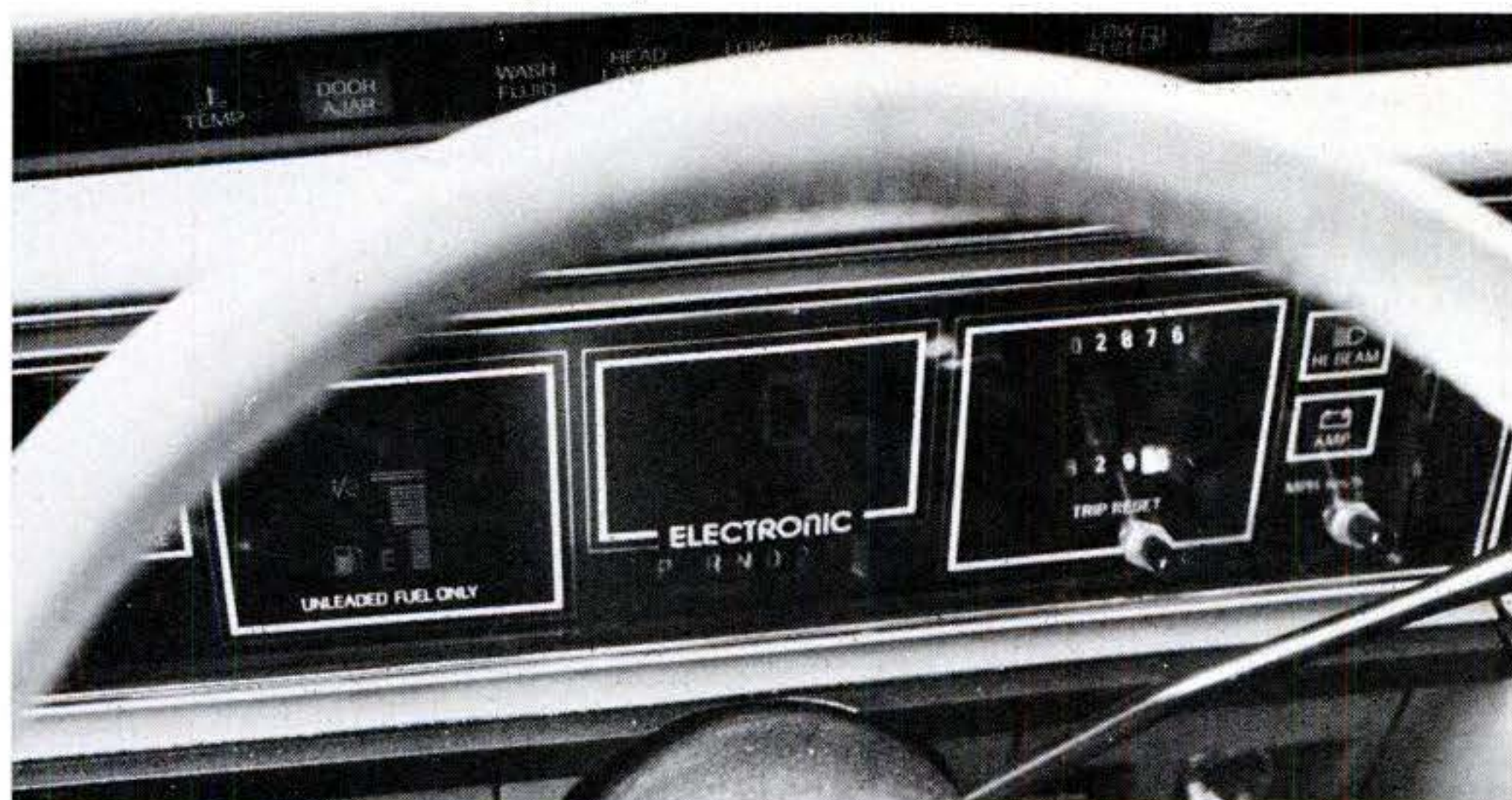
"IN COLD WEATHER, the heat pump reverses, adding heat to your home to keep you warm at low cost."

"With the rising cost of energy, you need more than a fair-weather friend. Call me. I'm in the Yellow Pages under Air Conditioning, Heat Pumps, or Heating. You'll have Carrier, the Year-round One, and me. Your Energy Allies™."



**UNITED
TECHNOLOGIES
CARRIER
AIR CONDITIONING**

Copyrighted material



Thunderbird's steering-wheel rim completely blocks from view the array of

another big improvement, although they don't fit everyone. They are narrower and considerably firmer than the standard seats and have sizable side bolsters to hold you firmly in place while cornering.

Good seats were important in the Thunderbird, because ride quality was easily a notch below that of the others in the group. On rough roadways the suspension bottomed all too frequently, sending a resounding jolt through the car. And depending on surface conditions, our car wallowed or pitched disturbingly.

Unfortunately, the Thunderbird's performance was disappointing in nearly all categories. The overworked six-cylinder engine was unable to surpass even the diesel's acceleration, and its 55-mph fuel economy was a dismal 17.6 mpg. We recommend one

warning lights across the top of the dash (shown only partially obscured here).

of the optional V8's; the six is just out of the question.

Cutlass Supreme diesel

Our test Cutlass Supreme's 5.7-liter (350 cu. in.) V8 diesel was the behemoth of the group in terms of displacement, but was more of an elderly pussycat in performance. It wasn't very fast, and made a bit more noise than the other engines, but it didn't require much food, either.

Fuel economy is its forte; our car delivered about 25 percent better economy at 55 mph than the top gas-powered competitor, Cordoba. The trade-off, of course, is power. As a result, acceleration is leisurely at best. Power is adequate for around-town and country driving, but calls for special attentiveness when entering an interstate highway or passing.

Because of the lack of vacuum in a diesel engine, brakes are hydraulically boosted. The result is a system that requires much less pedal effort and tends to be fairly touchy.

Typical diesel clatter is noticeable outside the car. The engine is about four or five decibels louder than a gasoline type, which is far more than the numbers suggest. But there is no difference inside at cruising speed.

Our Cutlass Supreme was slow, but plush and comfortable. And 25 percent more mpg is hard to overlook.

Our picks:

I'll take fuel economy over performance. From a group of comfortable coupes, I prefer the Cutlass.—J. D.

The choice comes down to Cordoba and Monte Carlo, with Cordoba looking better. It's very comfortable and far quieter; delivers better fuel economy, handling, and maneuverability; and is better in acceleration.—E. J.

For specs and test results, turn page

EPA fuel mileage (mpg)

	Chevrolet Monte Carlo	Chrysler Cordoba	Ford Thunderbird	Oldsmobile Cutlass diesel
Highway	27	26	24	34
City	19	17	18	23
Calif. city	18	16	18	22

PS fuel-mileage tests (steady-state mpg)

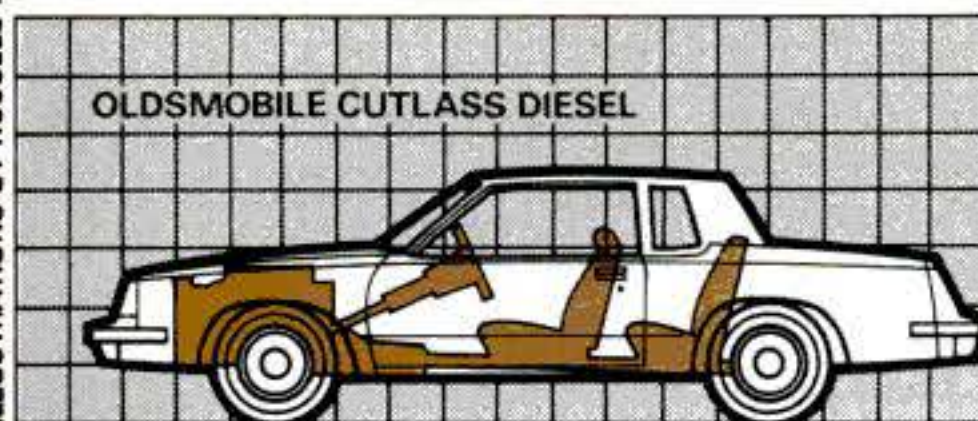
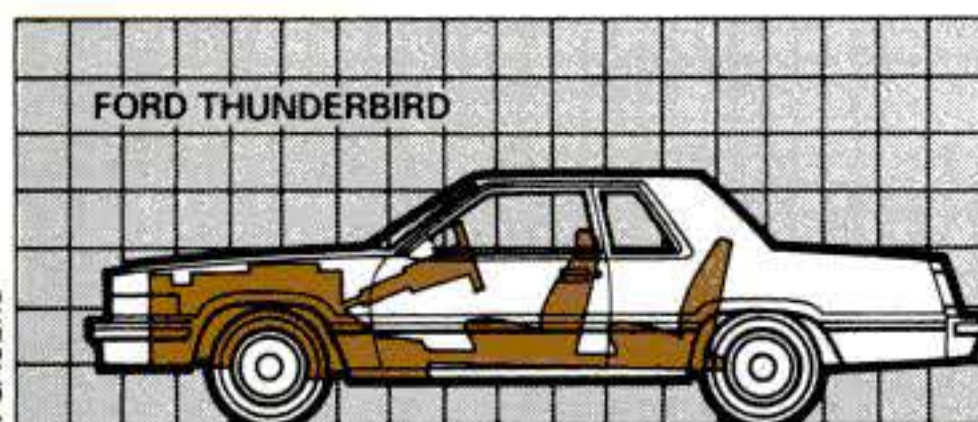
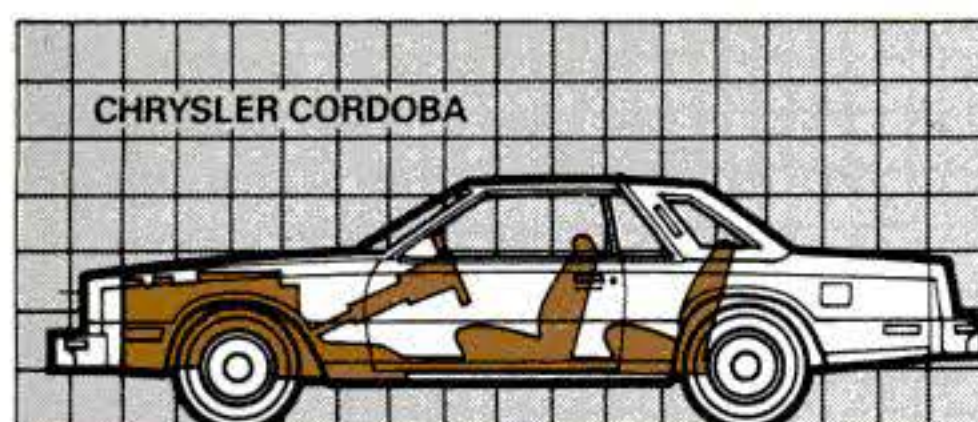
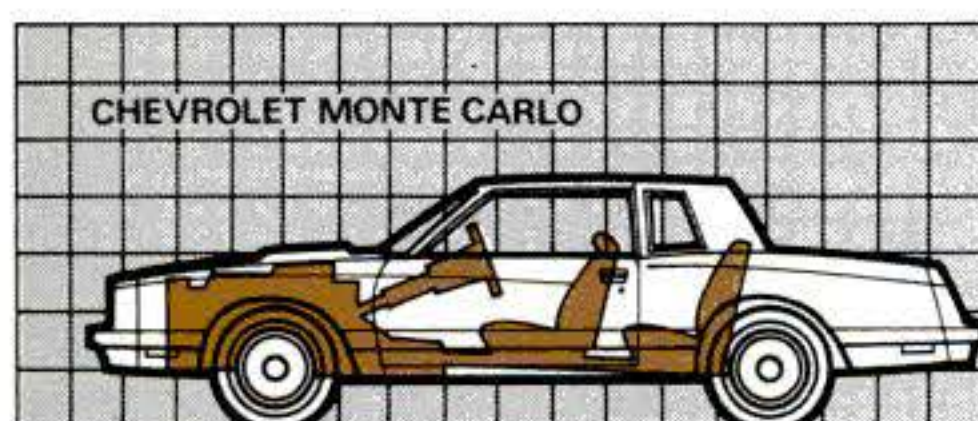
	24.0	24.3	23.8	33.7
35 mph				
55 mph	20.6	21.2	17.6	26.7



Air dams, like the one stretching across the underside of the Monte Carlo (above), keep air from flowing under the car. This would cause stability-upsetting lift, economy-robbing drag.

Grand-touring-type Recaro seats are optional on Thunderbird. Firm side bolsters hold passengers in place; the adjustable thigh supports can be individually positioned for maximum comfort.





ILLUSTRATIONS BY RUSSELL VON SAUERS

Sloping hoods and wedge profiles are becoming increasingly common as aerodynamic principles dictate the shapes necessary for optimal fuel economy.

PS serviceability ratings

How easy is it to service these cars? To give you an approximation of how difficult it is for a typical person to perform various service operations, we examine each test vehicle. The numbers mean: 1, very difficult; 2, difficult; 3, average degree of difficulty; 4, easy; 5, very easy.

	Chevrolet Monte Carlo	Chrysler Cordoba	Ford Thunderbird	Oldsmobile Cutlass diesel
Checking fluid levels				
Battery	5	5	5	5
Master cylinder	5	4	3	5
Windshield washer	5	5	5	5
Engine oil	2	3	4	3
Coolant	5	5	5	5
Checking the engine				
Spark plugs	1	3	4	n.a.
Distributor	1	2	3	n.a.
Carb adjustment	*	*	*	F.I.
Oil filter	3	2	3	3
Oil fill	3	1	1	2
Replacing hoses				
Upper radiator hose	3	4	4	5
Lower radiator hose	3	4	3	4
Heater hoses	2	3	1	4
Changing bulbs				
Headlights	1	3	3	1
Taillights	2	3	2	4
Front running lights	3	3	2	3
Front parking lights	3	4	1	3
Front directionals	3	4	1	3
Rear directionals	2	3	2	4
Rear running lights	3	3	3	4
Checking fuses	4	3	2	4
Spare-tire accessibility	4	3	3	4
Changing belts	2	2	2	2

*Sealed

Chevrolet Monte Carlo, Chrysler Cordoba, Ford Thunderbird, and Oldsmobile Cutlass diesel—dimensions, specs, and test results

	Chevrolet Monte Carlo	Chrysler Cordoba	Ford Thunderbird	Oldsmobile Cutlass diesel
DIMENSIONS (inches)				
Wheelbase	108.1	112.7	108.4	108.1
Overall length	200.4	209.8	200.4	200.0
Overall height	53.9	53.1	53.0	53.9
Overall width	71.8	72.7	74.1	71.6
Track, F/R	58.5/57.8	60.0/59.5	58.4/57.2	58.5/57.8
Ground clearance	6.7	7.6	6.3	6.7
Front head room	37.6	37.4	37.1	37.6
Front hip room	51.6	54.8	55.9	51.6
Front leg room	42.8	43.3	41.6	42.8
Rear head room	37.8	36.5	36.3	37.8
Rear hip room	54.9	57.2	52.0	54.9
Rear leg room (min.)	36.3	34.9	36.4	36.3
Rear knee room (min.)	2.1	0.6	1.8	2.1
Coupe distance	32.1	32.0	33.8	32.1
SPECIFICATIONS				
Engine type	V6 turbo	V8	In-line 6	V8 diesel
Displacement (cu. in./L)	231/3.8	318/5.2	200/3.3	350/5.7
Compression ratio	8.0:1	8.5:1	8.6:1	22.5:1
Carburetion	4-bbl.	2-bbl.	2-bbl.	F.I.
Net hp @ rpm	170 @ 4,000	120 @ 3,600	88 @ 3,800	105 @ 3,200
Net torque @ rpm	265 @ 2,400	245 @ 1,600	154 @ 1,400	205 @ 1,600
Transmission	Three-speed auto.	Three-speed auto.	Three-speed auto.	Three-speed auto.
Axle ratio	2.73:1	2.47:1	2.73:1	2.29:1
Tire make	Goodyear	Goodyear	Uniroyal	Uniroyal
Tire type	Polysteel radial	Polysteel radial	Royal Seal, steel-belted radial	Steel-belted radial
Tire size	P205/70R14	P205/70R15	P195/75R14	P205/70R14
Steering	Recirculating ball, power	Recirculating ball, power	Rack and pinion, power	Recirculating ball, power
Overall steering ratio	Variable 16.4-14.2:1	18.7:1	Variable 20.7-17.9:1	Variable 16.4-14.2:1
Turns, lock to lock	3.3	3.5	3.4	3.3
Turn diameter (ft.)	38.2	40.7	40.7	38.2
Front suspension	Independent, unequal-length A-arms, coil springs	Independent, non-parallel control arms, torsion bars	Independent, hybrid MacPherson struts	Independent, unequal-length A-arms, coil springs
Rear suspension	Solid axle, four control links, coil springs	Solid axle, Hotchkiss, semi-elliptical leaf springs	Solid axle, four control links, coil springs	Solid axle, four control links, coil springs
Front stabilizer-bar diameter (in.)	1.06	1.00	1.13	0.98
Rear stabilizer-bar diameter (in.)	0.63	0.75	None	0.63
Trailer towing (max. lbs.)	2,000	2,000	Not recommended	2,000
Trailer tongue weight (max. lbs.)	200	200	Not recommended	200
Brakes	Disc/drum, power	Disc/drum, power	Disc/drum, power	Disc/drum, power
Brake swept area (sq. in.)	307.8	375.0	275.0	307.8
Fuel tank (gal.)	18.1	18.0	17.5	18.1
Trunk space (cu. ft.)	16.1	16.7	17.7	16.1
Liftover height (in.)	29.6	30.0	28.5	29.6
Curb weight (lbs.)	3,189	3,520	2,900	3,300
F/R weight distribution (%)	56/44	59/41	57/43	56/44
Basic price	\$7,799	\$7,969	\$7,757	\$7,249
Price as tested	\$10,905	\$10,235	\$11,094	\$9,426
Major options (over \$100) on test car	A/C \$557, power seats \$162, power windows \$133, cruise control \$123, turbo engine \$750, AM/FM stereo \$178, aluminum wheels \$249, custom interior \$190	A/C and basic group \$908, handling package \$240, power windows \$145, AM/FM-search stereo \$211, wheel covers \$160, cruise control \$136, rear defogger \$107	A/C \$557, Recaro seats \$376, electronic instrument panel \$268, cruise control \$113, AM/FM stereo \$321, luxury interior \$985, premium sound \$146, power door locks \$111	A/C \$557, power windows \$133, diesel engine \$645

TEST RESULTS

Acceleration (sec.)				
0-60 mph	13.3	13.3	23.0	22.8
25-70 mph	15.5	15.0		
Brake test (cool) 60-0 mph				
Stopping distance (ft.)	230	193	185	183**
Pedal pressure (lbs.)	80	132	120	60
Brake test (hot) 60-0 mph				
Stopping distance (ft.)	186	177	193	208
Pedal pressure (lbs.)	84	181	160	34
Interior noise @ 60 mph (dBA)	72	67	72	72
Handling test (mph)	64.0	65.0+	59.0	58.4
Maneuverability test (mph)	27.6+	27.6+	26.4	26.6

TEST CONDITIONS: Ambient temperature, 26°F; relative humidity, 40 percent; barometric pressure, 30.06 inches Hg

*Could not reach 70 mph in specified distance

**Measured manually

Performance comparison with selected models

	Mpg (city driving)	Acceleration 0-60 mph (sec.)	Brakes 60-0 mph (hot) (ft.)	Handling (mph)	Maneuverability (mph)	Noise @ 60 mph (dBA)
1980 Ford Thunderbird V8	17	11.9	147	62.4	27.6+	69
1980 Chrysler Cordoba in-line 6	17	16.5	150	58.2	27.2	68
1980 Dodge Mirada V8	15	17.1	230	62.4	27.6+	68
1980 Chevrolet Monte Carlo turbo V6	18	12.7	128	60.0	27.6+	65
1980 Pontiac Grand Prix V6	20	15.7	162	58.2	26.4	67
1978 Ford Thunderbird V8	10	12.8	174	51.3	22.4	63

Ford Club Wagons out-carry and out-tow any station wagon.



1981 Ford Club Wagon puts it all together: combining interior luxury with room that outshines conventional station wagons. Built Ford Tough: separate body-on-frame construction, Twin-I-Beam suspension. And ask your Ford Dealer about Ford's Extended Service Plan.

Compare Ford's Club with Chevy's Suburban or any station wagon!

- Ford E-100 standard six-cylinder Club is EPA-rated 17 estimated MPG. Chevy's Suburban with standard V-8: 16 estimated MPG.
- With the standard quick-release bench seat removed, Ford Club Wagon has more cargo length than Suburban.
- Ford Club Wagon offers spacious interior and more front seat headroom and available seating arrangements than Chevrolet Suburban.
- Ford's engine choices include economical Six. Suburban's smallest is a V-8.



Tows more. Ford offers light- and heavy-duty towing options that can handle up to 8,000 lbs. of trailer and equipment... more than any station wagon.



Great gas mileage

17 EPA EST. MPG **22** EST. HWY.*

*300 Six, standard transmission. Compare these estimates with others. Your mileage may differ, depending on speed, distance and weather. Actual highway mileage will probably be less. California estimates lower.



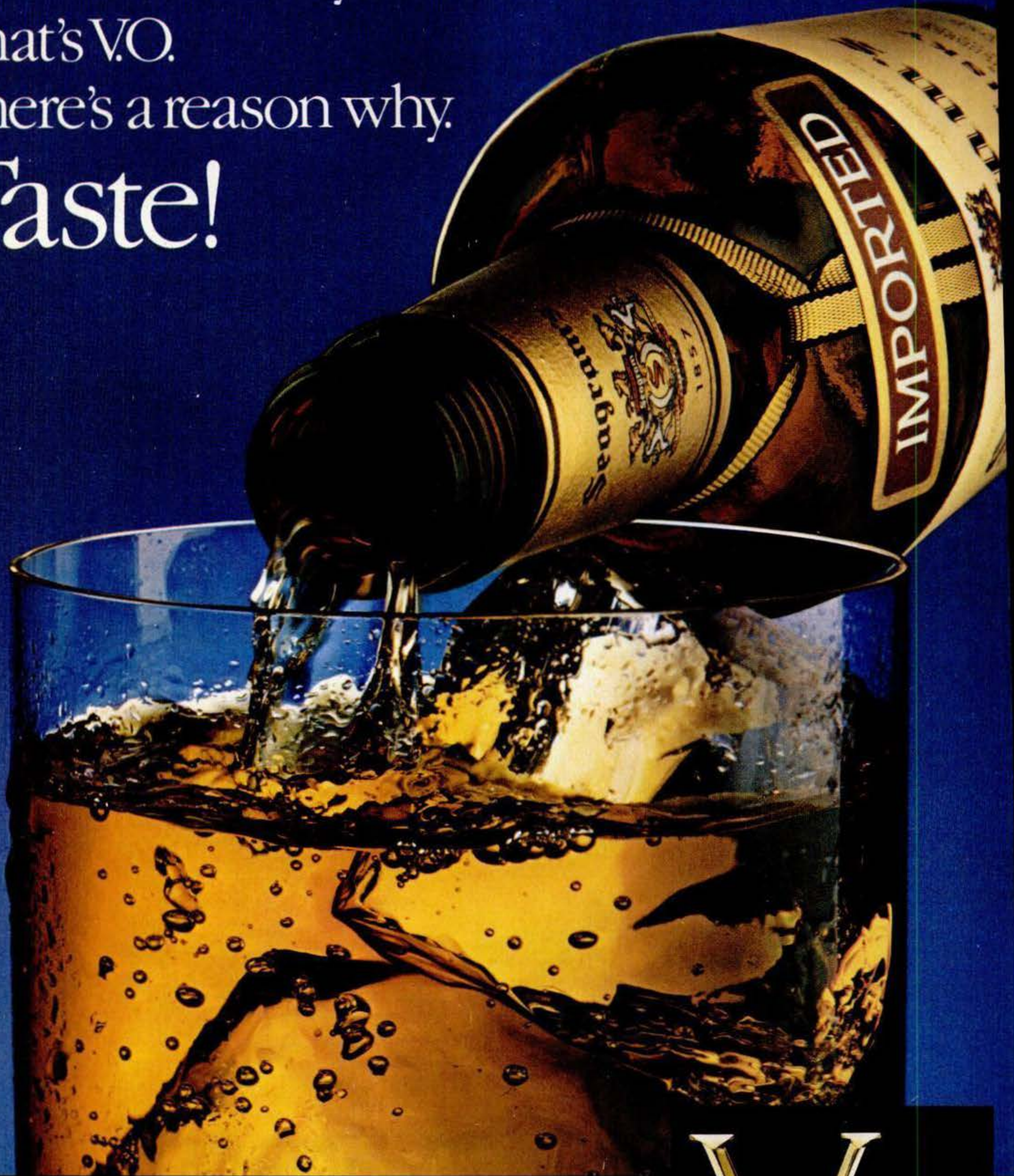
Seats more. Ford Club Wagon carries up to 12 (15 in Super Wagon) vs. Chevy Suburban's nine, and Ford offers more seating arrangements.

FORD

FORD DIVISION



There are over 3000 imported whiskies
in America. Only one can be the best-seller.
That's V.O.
There's a reason why.
Taste!



More V.O. is bought than any other imported
distilled spirit in America. More than any Scotch,
Canadian, Rum, Gin, Vodka, Tequila. You name it.
Enjoy our quality in moderation.

CANADIAN WHISKY. A BLEND OF CANADA'S FINEST WHISKIES. 6 YEARS OLD. 86.8 PROOF. SEAGRAM DISTILLERS CO., N.Y.C.

V.O.

PS | What's News

Our local star—the sun—is still a pretty mysterious object. We've got some ideas about how it generates its energy, but there are gaps in our understanding.

During much of 1980, the sun was at the peak of its 11-year cycle of activity. Far more sunspots than usual moved across its surface; huge solar flares, loops, and prominences soared above its surface, releasing prodigious amounts of energy. It was in an ideal state for study.

During this period, the Solar Maximum Mission satellite—Solar Max for short—had been in orbit, all sensors trained on the sun. At the same time, solar physicists on the ground had all their available instruments pointed at the sun's surface. One of the physicists was Stephen Maran of NASA's Goddard Space Flight Center in Maryland. You may remember that Dr. Maran wrote the Popular Science piece on meteorites in the April 1980 issue. And he was the obvious choice to tell about the picture of the sun that he and his colleagues are piecing together from the information that flowed to Earth.

The cover painting, showing the sun's structure as we now understand it, is by Ray Pioch. The story begins on page 66.

Help for inventors

Last August in this space I wrote that the American Patent Law Assn. had established a new service to help inventors protect and exploit their inventions. I said the organization had a booklet on the subject for sale and would offer free legal advice to anyone who requested it.

It turns out that announcement was a bit premature. Michael W. Blommer writes that the booklet was not available at that time—a fact he has had to write and tell some 4,000 Popular Science readers who wrote in. But, Mr. Blommer says, the booklet is available now. It is about 100 pages in length; will provide sound, authoritative advice to inventors; and is called "How to Protect and Benefit From Your Ideas."

If you'd like to have the booklet, write Mr. Blommer at the American Patent Law Assn., Suite 203, 2001 Jefferson Davis Highway, Arlington, Va. The price is \$15. If you have questions after reading the booklet, there is a tear-out questionnaire enclosed. Fill it out and send it to APLA headquarters. There, your needs and location will be matched with one of APLA's

volunteer lawyers. You can then call for an appointment for a free half-hour of consultation.

Cellular mobile telephones

At the moment, only 700 people in New York City can have mobile telephones in their cars, despite the fact that thousands would like them. The same general situation exists in many other cities. That's because there just isn't enough space in the crowded electromagnetic spectrum for more traffic. Now the FCC seems on the verge of approving a brand-new system that could change things dramatically. For example, the new arrangement would make it possible to go from 700 to hundreds of thousands of mobile telephones in New York and to make comparable expansions of service elsewhere. And while today's mobile-telephone signals are often noisy and unreliable, the new system would produce signals as good as those on conventional phones.

Making all this possible is a concept called "cellular radio" [PS, Jan. '78]. Instead of handling all signals from a centrally located high-powered transmitting facility, the phone company will scatter dozens or hundreds of small, low-powered transmitter-receiver stations all around a given area. As you move from one of these "cells" to another, a computer will keep track of your location and automatically switch your traffic from one station to another and even from one channel to another. The switch won't interrupt your call; you won't even know it's happening. Thus many different cars can all be using the same frequency simultaneously.

Mail debate

The General Accounting Office, an investigative branch of Congress, has just completed a study of the impact of electronic mail on the future of the Postal Service. In most of the electronic-mail schemes [PS, Sept. '80], letters would be sent electronically from one city to another, reconstituted on paper at the destination post office, then delivered with the regular mail. The result, as planned, would be guaranteed overnight delivery.

Now the GAO study says that such a system will have a major impact on the Postal Service. Over the next 20 years,

says GAO, electronic mail will take over a huge part of the total job. By the year 2000 almost 30 billion pieces of mail a year will be handled this way, cutting employment in the Postal Service from today's figure of 600,000 to 200,000.

The Postal Service disagrees. The new system would not simply divert present mail to the electronic delivery system, says Postmaster General William F. Bolger. It will create a lot of new business.

It's an outstanding example of how technology can shake up standard ways of doing business and bring about changes that not even the experts can predict.

Electronic window watching

Boston's famed John Hancock Tower has been widely praised by architects. But its neighbors have been less than thrilled during the eight years of its existence. Main source of the displeasure: Thousands of the building's huge glass windows have broken and come tumbling down onto the sidewalk [PS, Oct. '75].

The trouble has been traced to winds and low-pressure areas triggered by the 52-story tower's aerodynamic effect, and to some flexing of the basic structure.

In 1975, all 10,344 panes of glass were replaced with heavier sheets. And other changes were made in the attempt to stop the hail of broken glass onto sidewalks below. It's been pretty successful; only about 55 panes have fractured during the last five years. To spot these fractures before the glass fell, the Hancock building had a staff of window watchers spotted around Boston, studying the building with telescopes. Before a window fell, it changed slightly in color.

Now electronic sensors have been installed to replace the human watch. Each time a sensor indicates that fracture is imminent, the building crew reverses the ventilation system in that section, lowering the pressure inside. That holds the glass in until crews can replace it.



Editor-in-Chief

Flat-screen TV

— almost here?

Pocket-size models may be in the stores soon. Big hang-on-the-wall color panels? Mid-1980's

By JOHN FREE

NORTHBROOK, ILL.

It was a curious TV display. The 10-inch screen showed just the upper corner of black-and-white TV pictures. I saw sections of images—an actor's ear, someone's hair, part of a door. "Here," said Joseph Markin, president of Lucitron, Inc., "look in this mirror."

In a full-length mirror in one corner of the lab, I could view the small screen as though it were at a distance. I could also compare its images—a "Happy Days" rerun from nearby Chicago—with complete pictures on an ordinary 19-inch receiver just behind the 10-inch screen. Overall, picture quality was similar on the two screens.

Lucitron researchers have been showing this setup to a number of display specialists. The center of attention is the 10-inch screen, part of a panel less than three inches thick; it displays images with hundreds of tiny elements, similar to individual lamps rather than a conventional picture tube. Circuits to Lucitron's Flatscreen are adjusted to show only the picture that would be displayed if the small screen had been "sliced" from a larger, 35-inch panel that was still being assembled.

Lucitron, with financial backing from General Telephone and Electronics, believes it has devised flat-panel technology that will eventually compete with ordinary cathode-ray

tubes (CRT's) and giant-screen projection TV's, as well.

But that will be some time off. Companies have been attempting to perfect display devices superior to CRT's for decades, only to see the bulky, pyramid-shaped vacuum tubes inch upward in performance and down in cost. Lucitron plans to market its big 35-inch Flatscreen soon. The trademarked, monochrome panel will be used initially for alphanumeric displays, computer graphics, and perhaps special TV displays.

Most experts believe large, hang-on-the-wall color-TV panels won't be ready until the second half of this decade. But portable, hand-held models with monochrome screens should be available in 1982 or sooner. A wide range of materials, including liquid crystals and solid-state electroluminescent (EL) films, are being used for upcoming portable flat-screen TV's.

Bigger isn't better

Why not just make bigger CRT's instead of flat-screen panels? Turning a corner at Video Expo in New York's Madison Square Garden last fall, I saw a startling display that helped explain why. Sony was demonstrating its new 30-inch-diagonal professional monitor/receiver. The color images on it were dazzlingly bright and exceptionally sharp. But the set, I learned, weighs 275 pounds—much of it contributed by the extra-thick CRT glass needed to prevent an implosion from the tube's vacuum. And that modest increase in tube size helped push Sony's CVM-3000 to over \$8,000.

Lucitron, formed five years ago by Zenith Radio Corp. personnel when the TV firm closed its research department, plans a direct attack on CRT's where they're weakest: size. "We

expect to have put together and operated our first 35-inch [panel] by about mid-year," Markin told me. In another small lab nearby he pointed to a rectangular plastic frame awaiting installation of the 35-inch Flatscreen. Several printed-circuit boards were connected to the back of the frame.

"There's about twice as much electronics as will be necessary," he said, referring to the area of the boards. Customized microcircuits will shrink the space needed—a staggering reduction compared with the six-foot-high cabinet packed with circuits needed for early Flatscreens. The Lucitron panel, and most flat screens, need special circuits to feed drive signals to electrodes along the edges of the display. Drive signals are timed so they illuminate individual picture elements, or pixels, when they meet at the intersection of horizontal rows and vertical columns.

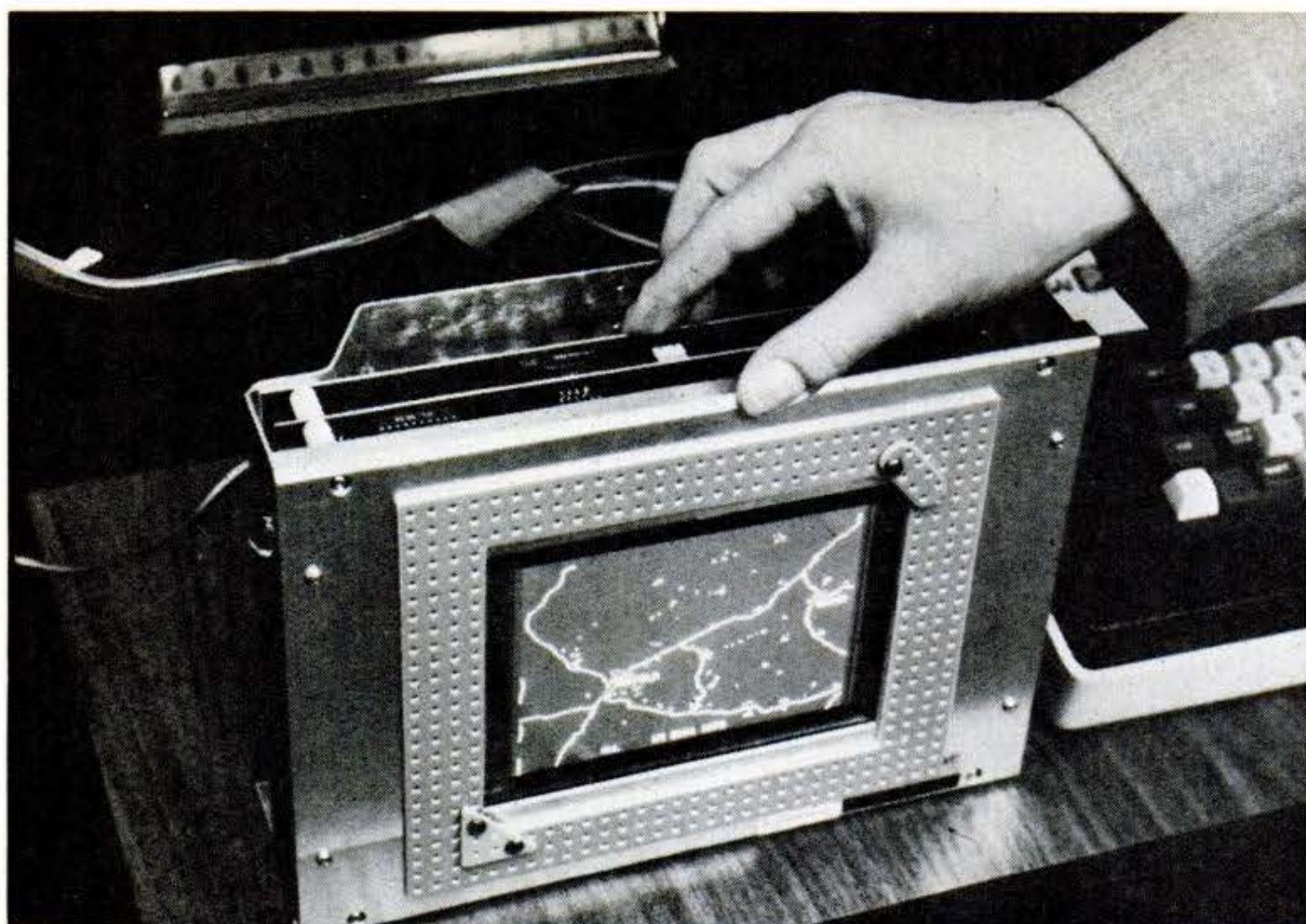
Lucitron is cautious about disclosing details of Flatscreen, since firms in Japan and elsewhere are perfecting similar DC-plasma panels. Markin believes Flatscreen has an edge over potential competitors because of its luminous efficiency (light output per unit of input power). The initial Flatscreen, for military and industrial applications, will deliver about three lumens per watt, about the same efficiency as the shadow-mask, color-picture tube. That's about 10 or more times as efficient as other plasma panels under development, says Markin.

At one location in Lucitron's small plant I saw the back part (cathode) of a 35-inch panel being tested. This section appeared to be a series of narrow channels, each with a metallic electrode surrounded by gases with a violet glow. Lucitron has built com-

Continued



Pocket-size TV, shown in prototype form (top), is a liquid-crystal set from Toshiba with a two-inch screen. A zoom-in switch enables you to enlarge the central part of the screen image. Sinclair Research's Microvision (right) has three-inch flat CRT.



Flat-screen panel used by Army for research shows computer-graphics display of a map area. The Hycom panel has 320 horizontal and 240 vertical thin-film EL elements. A transparent, touch-sensitive screen (removed for picture) enables you to tap areas on the screen for enlargement by the computer. An off-the-air TV picture, right, was on a similar EL panel.



plexity into Flatscreen that greatly simplifies and reduces the number of drive circuits needed.

The first panel will have about 14 pixels per horizontal inch, not adequate for full-resolution TV pictures. "We have already done work that indicates we can get 30 elements per inch," says Markin, "and before we're done I think we'll be somewhere between 50 and 70 elements per inch." Such pixel density in a 50-inch screen could provide over 1,200 horizontal color elements—some three times more horizontal resolution than TV stations can now broadcast. Such panels could one day be used with super-fidelity TV broadcast by satellites, carried by cable, or put on videodiscs.

"Color is just a matter of putting phosphors down in the right place," says Markin. "It's not a matter of science or research. It's just a matter of some careful engineering—to be more exact, some manufacturing details. For the last two years what we've really been working on is how to make these cheaper and cheaper," he said.

"I think a number of people will be surprised how low in cost this type of panel can be," Markin added. "Natu-

rally, they won't believe it until we start selling them."

At the U.S. Army's electronics research center in Ft. Monmouth, N.J., I saw a different type of panel that is already being marketed by Hycom Inc. (Irvine, Calif.). This small, solid-state EL panel (see photo) has 320 horizontal and 240 vertical elements. Sharp, the manufacturer, has shown its thin-film EL technology in experimental TV's at electronics shows. But the thin-film material used, zinc sulphide doped with manganese, emits a greenish-yellow light not suitable for consumer TV's.

The Army is interested in EL because computer technology for use under battlefield conditions is expanding. "It does what a CRT can do but in a very small, rugged package," explained Dr. Elliot Schlam. Sharp's thin-film EL panels are also light and require relatively little power, properties that make them ideal for take-along TV's once an EL material that doesn't give off a distracting hue is developed.

Schlam showed me a slightly larger panel with extraordinary 648 by 512 resolution. This Sharp panel is trans-

lucent. It can be placed over a map and connected to a computer that can continually update battlefield information on the display for different regions. But the see-through aspect of EL films may also be useful for color TV's. Instead of having a cluster of adjacent red, green, and blue color elements forming a picture, as on most conventional color screens, translucent EL elements could be superimposed atop one another, improving resolution.

But the race for portable flat-screen TV's—at the moment—seems to be between monochrome liquid-crystal models and a type of CRT developed by Sinclair Research in England.

Hitachi, Matsushita, and Toshiba have shown pocket-size LCD TV prototypes. Liquid crystals have the advantage of consuming very little power, but the images may have poor contrast with restricted viewing angles, and smear with rapid picture changes. The Japanese are working out the final technical problems and may begin marketing LCD TV's in 1982.

That's also when Sinclair plans to introduce its \$125 Microvision, built around a flattened CRT with half the volume of a conventional picture tube. Timex Corp. in Scotland will make the Sinclair portables, which have a three-inch screen and include an FM radio. In the Microvisions, an electron gun is positioned to the side of and parallel with the phosphor screen ["Look and Listen," PS, Nov. '80]. According to PS European Editor David Scott, who attended Sinclair's London press conference, the flat CRT may also be combined with Sinclair's ultra-compact ZX-80 personal computer [PS cover, Nov. '80].

For the second half of the decade, RCA is also developing a flat-screen TV display with electron beams that travel parallel to the screen until they're deflected at a right angle onto the phosphors. RCA's 50-inch flat CRT is somewhat similar to the shadow-mask picture tube in today's color sets (see "Look and Listen," PS, July '80). The edges of narrow vertical channels in the panel would provide structural support for the CRT face.

Lucitron's Markin hopes to have large color displays ready by then, too. Stopping before a rack specially designed to hold glass sheets over seven feet, diagonally, he said: "Our only limitation is how large you can make a piece of window glass." PS

FOR FURTHER READING
International Symposium Digest of Technical Papers, Society for Information Display, 1980 (654 N. Sepulveda Blvd., Los Angeles CA 90049).
"Recent Advances in Display Technologies," I. F. Chang, *Proceedings of the Society for Information Display*, Vol. 21/2, 1980.



Y-tailing it into the 21st century: Advanced-design Lear Fan 2100

During its flight-test program, the Lear Fan 2100 prototype has proved docile and easy to fly, closely matching computer predictions.

**Twin inboard engines
driving a pusher prop
give 11 mpg at 350 mph**

By ED JACOBS

RENO, NEV.

"We're looking at the shape of aviation's future," a fascinated expert remarked as we watched the Lear Fan 2100 being readied for an engine test. "In fact, what Lear Fan is doing here may be 20 years ahead of everyone else."

What Lear Fan is doing is building an extraordinary aircraft, of the sort that comes along only once a decade or so. In a field where progress is measured in painfully small steps, this business plane's combination of new technology and proved but little-heeded concepts promises a quantum leap.

What makes it so different?

- The first advanced-composites airframe.

- A shape dictated by aerodynamic needs, not structural constraints.

- 11-mpg economy at 350 mph.

- Unique, twin-engine propulsion with a tail-mounted propeller.

- A new tail configuration.

- Pioneering in the design and manufacturing techniques of composite aircraft.

The Lear Fan 2100 is both exotic and beautiful. Your eyes are immediately drawn to the unusual Y-shaped tail and the single four-bladed propeller mounted behind it. Then you slowly realize that there isn't a straight line anywhere in the fuselage—that it is one continuously curving, enormously elongated teardrop more than 40 feet long. Head on, the combination is almost sinister looking.

The plane is the last major project of the late William P. Lear, the flamboyant inventor/industrialist whose accomplishments included eight-track

stereo, the first automatic direction finder, the first autopilots for small planes and military fighters, and the original Learjets—which many people still consider to be the ultimate status symbols.

The key element: composites

Perhaps the most significant of the Lear Fan's numerous advances is its near-total fabrication from graphite-epoxy and Kevlar. It is not, however, the first all-composite production airplane. The plywood-composite De Havilland Mosquito fighter-bomber probably was. More than 7,800 were manufactured during World War II. Other all-composite aircraft include the Wassmer WE-51 Pacific and LFU-205 [PS, Oct. '69], Windecker Eagle, and Bellanca Skyrocket, all of which were fiberglass. The Lear Fan isn't the first successful pusher-type aircraft, either; the original Wright Flyer was.

Continued

Engineers and technicians scrutinize the engines, transmission, and propeller during ground testing with the nacelles off and special heat shields in place.

Neither point diminishes the significance of the airplane. By building virtually the entire aircraft from graphite-epoxy, with some Kevlar, Lear Fan is developing new design and manufacturing techniques essential to plans now being formulated by the major aircraft manufacturers for tomorrow's more sophisticated and fuel-efficient planes.

Because of this, there is outstanding cooperation between the big firms and Lear Fan. Boeing, for instance, is sharing its composites-fabrication and tooling experience, while McDonnell Douglas is sharing structural-design expertise. This is being added to the rapidly expanding store of knowledge from Lear Fan's own extensive development activities.

According to Production Manager Bob Jacobs, so much was learned so quickly during the design, construction, and early testing of the first prototype that the second one will be a true second-generation plane. Although a foot longer (to gain some additional interior room), it will look the same on the outside. But under the paint, the production-design airframe will be put together in an almost totally different manner.

New design flexibility

Why are composite materials so important to the Lear Fan and future aircraft? "From an aerodynamicist's viewpoint," I was told by Aerodynamics Supervisor Bob Jacobsen, "composites allow design flexibility never before available. They allow shapes determined primarily by aerodynamics, not structural considerations." The resulting surface is so perfectly shaped and free of imperfections that profile drag is greatly reduced.

Sizable weight reductions can accompany the use of composites. Besides being lighter, their special characteristics sometimes allow construction techniques that can bring further weight savings. Jacobsen points out that the Lear Fan is about 12 percent lighter than a similar design made of aluminum would be. Compared with a *conventional* aluminum design, with the engines in wing-mounted nacelles, Lear Fan is 30 percent lighter.

Manufacturing is easier, too. You can "tailor in" added strength where you need it just by adding a few more plies of material, says Vice-President Tony Green. In addition, composites don't fatigue, and they don't corrode. On the negative side, composites are

brittle; but they do not tear after being punctured.

The aerodynamic efficiency and light weight offered by composites, coupled with a unique "inboard" turboprop propulsion system, give the Lear Fan impressive performance. It can fly 420 mph and has a service ceiling of 41,000 ft. Cruising at 350 mph with a full load of six to eight executives, it is designed to deliver 11 mpg—twice the economy of any other turboprop; four times that of a turbojet.

Indeed, the Lear Fan would probably deliver better fuel economy than either of the two limousines necessary to ferry the executives to the airport—and travels more than 300 mph faster. Furthermore, 11 mpg is better than the EPA city-fuel-economy ratings for 11 cars and vans.

The propulsion system for the Lear Fan sounds as new as it is thrifty. It is, too—for airplanes. But the basic principle of two turboshaft engines connected to a single transmission is common in helicopters.

The system offers a number of advantages. The engines are 650-hp Pratt & Whitney of Canada PT6B-35F's. They weigh a bit less than 320 lbs. each, and are so slim that they fit within the fuselage. That means a sizable drag reduction—no wing-mounted engines and nacelles.

Since both engines are tied to it, the transmission automatically functions as a turbine-speed synchronizer, simplifying engine controls. In case of an engine failure, one-way clutches automatically uncouple the bad engine without affecting the good one.

Because the propeller is mounted on the aircraft's longitudinal center line, there is only a normal reduction of

power when one engine shuts down. There is no asymmetric power delivery to suddenly contend with—the cause of many accidents in conventional twin-engine planes.

The prop: Kevlar and steel

Flight testing is now being done with a four-bladed composite prop. The straight blades are made of Kevlar, with stainless-steel leading edges for erosion resistance and lightning-strike protection.

What is even more interesting, though, is the design being developed for production: curved blades with about a 45-degree sweep. It is reminiscent of some of the exotic blades being developed by NASA, although it won't have the extreme scimitar shape, which would be too heavy and difficult to mass-produce. Increased efficiency and quieter operation are the goals of the new design, although the plane is already extremely quiet.

Like the current design, the new prop will be made initially of Kevlar. Graphite isn't out of the question, however, either by itself or in combination with Kevlar. For even greater efficiency, a special "cuff" will maintain the new propeller's airfoil shape all the way to the hub.

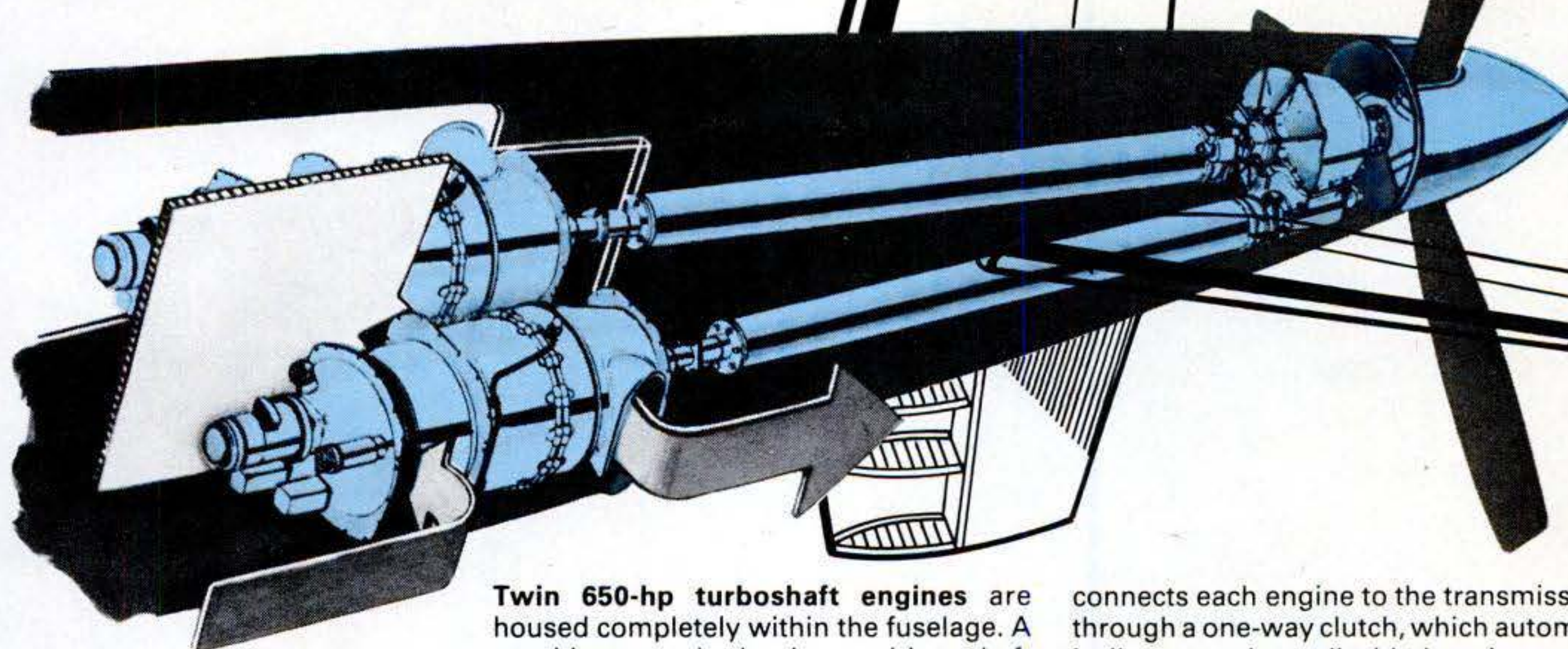
Would counterrotating propellers be more efficient? Yes, said Bob Jacobsen, but they'd add much undesirable weight and complexity.

Why a Y-tail?

The most visually striking feature of the Lear Fan is the unusual Y-shaped tail. The original concept called for a high-T tail with a chain-driven propeller mounted at the top, but the idea was rejected. Next was an



Lear Fan 2100's unique propulsion system



Twin 650-hp turboshaft engines are housed completely within the fuselage. A graphite-wound aluminum drive shaft connects each engine to the transmission through a one-way clutch, which automatically uncouples a disabled engine.

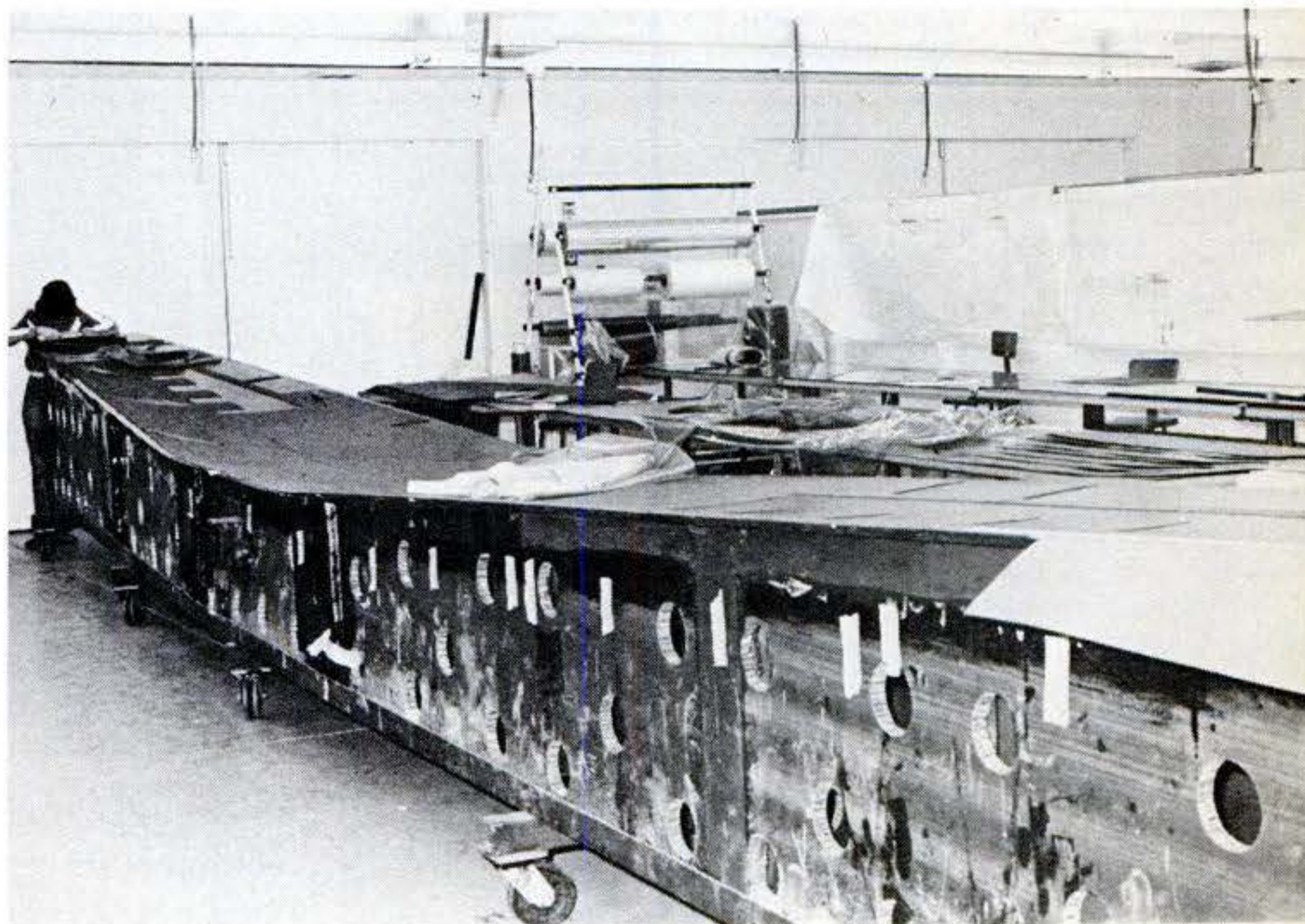
anhedral (inverted V) design, which proved unstable in wind-tunnel testing and was superseded by conventional and cruciform configurations before the Y-type was selected.

The Y-tail does a number of things for the aircraft: It protects the propeller from striking the ground. It gives separate control surfaces and activating systems for the rudder and elevators, which a V-type would not. (A V-type would require a control mixer, which could introduce the possibility of asymmetrical control response.) And the Y-tail design places each control surface in "clean" (undisturbed) air for maximum effectiveness.

Fuel efficiency and simplicity were the prime goals in designing the Lear Fan, so a straight wing was selected. A swept wing would have been heavier and more complicated to build, and wasn't needed, anyway. For greater efficiency, the flaps move to a five-degree up position to reduce cruise drag. For simplicity, all control systems are mechanical; there are no electrical or hydraulic assists.

Testing by computer

Besides economy, great emphasis was also placed on high performance and good handling characteristics. Prior to the maiden flight, special flight simulations were performed to see what the Lear Fan would be like. A mathematical model of the plane was fed into the computer aboard a specially modified Douglas B-26 owned by Calspan Corp. By integrating the pilots' control movements with the mathematical model, the computer manipulated the B-26's controls so it would respond as the Lear Fan should.



Both top and bottom wing skins are laid up in one continuous piece, 39 ft. long,

with up to 72 plies in some areas. The one-piece wing spars contain 85 plies.

When actual test flying began, the simulations proved quite accurate. The plane was both smooth and very easy to fly. There were no problems, and all surprises were pleasant.

Cost: \$1.6 million

The results must be reassuring to the record 180 companies, flying clubs, and individuals who bought the \$1.6 million plane before it ever flew. (By contrast, only three of the ultra-sexy Learjets were sold before its first flight.)

Getting this far hasn't been easy—\$30 million in venture capital had to be raised to set up U.S. design and test facilities. Then \$70 million had to be arranged to set up manufacturing

facilities in Northern Ireland, where the planes will be assembled prior to being ferried back here for finishing touches.

What lies ahead isn't going to be easy, either. Certification in the U.S. will take another year, since much new technology must be proved airworthy. Certification in England will take a bit longer, complicated by the fact that the Lear Fan falls neatly between Britain's regulations for single-engine aircraft and twins. Some cool-headed interpretation of the rules could ease that procedure. Lastly, there is sniping from competitors to be endured. It didn't stop Bill Lear in his day, though, and it isn't likely to stop his successors.



Solar Challenger

Powered by 16,000 photovoltaic cells, the unique craft soars to 3,800 feet on sunbeam power alone

By **JIM SCHEFTER**

PHOTOS BY RANDA BISHOP

The morning air in California's Mojave Desert held a chilly November bite, yet Paul MacCready paced about in front of the hangar in a sport coat and open-neck shirt. Two young boys played on the edges of El Mirage airstrip while photographers waited nearby. MacCready watched the winter sun crawl slowly to an acceptable angle. Just at mid-morning, he signaled the okay.

"Bring it out," he called. Five eager workers gently pushed MacCready's latest flying machine into the sunlight. Looking like a grounded gull, Solar Challenger—the world's first and only aircraft designed to be all-solar—began its short journey to the El Mirage test runway.

MacCready gained fame, and true pioneer status in the aviation world, with his Gossamer series of aircraft. Lightweight to the point of flimsiness, the Gossamer Condor became, in 1977, the first human-powered aircraft to fly a prescribed closed course [PS, Jan. '78]. A year later, its much-improved successor, Gossamer Albatross [PS, Dec.

'78], crossed the English Channel in two hours, 49 minutes.

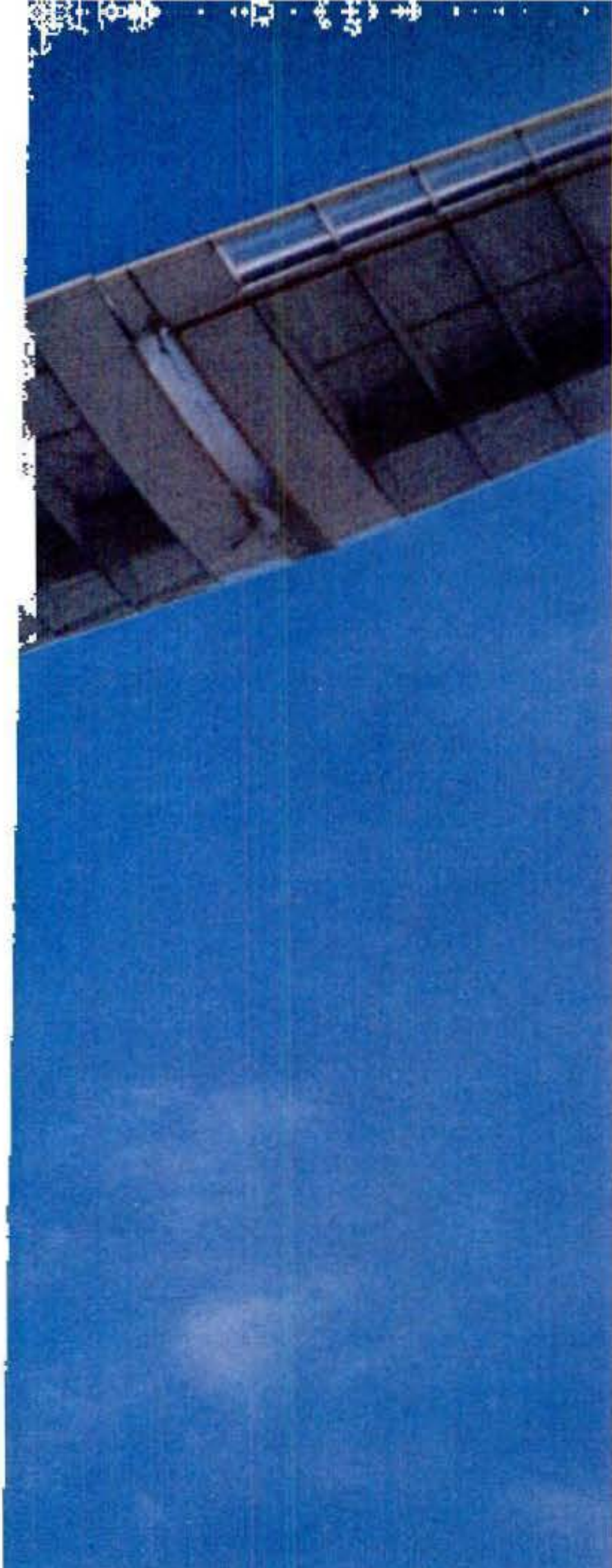
Now MacCready is back with an aircraft that gets 100 percent of its power from the sun. Solar Challenger, built by his company, AeroVironment, carries no batteries of any kind. Photovoltaic cells glistening on its 45-foot wing and its 10-foot, nine-inch tail are the only source of electrical power for its motor.

"Stay behind the plane," MacCready shouted to the growing crowd escorting Challenger. "Don't raise any dust." He paused to explain that a dust coating on the sensitive solar cells can cut their output by 50 percent. "We can't afford to lose any power on a day like this. The sun angle at this time of year is already marginal for good flying."

But fly it did. With Challenger turned by its crew to aim down the runway, 95-pound Janice Brown ran a quick check on the electrical system. An experienced commercial pilot, the 32-year-old former teacher was chosen by MacCready as much for her proved flight skills as for her light weight. Increasing voltage to the motor, she let Challenger begin to move. A single crewman sprinted alongside, keeping the wing level while lift forces built up.

Then Challenger pulled away. In any other airplane, the speed would seem ludicrous. The unique craft reached takeoff velocity, broke free of the ground, and almost

Continued



Banking slightly to catch rays from the low-hanging winter sun (below), Solar Challenger soars on solar power alone. The Mylar-covered pilot's pod (left) hangs suspended beneath lightweight but strong wings. They're fashioned with Kevlar ribs and honeycomb-core spars. These broad, uptilting wings are designed as a sun-catching platform for the thousands of solar cells that pave their surface (bottom). The cells are the sole power source for the plane's small engine.



floated away from the desert runway without quite reaching 19 miles per hour. The crowd cheered, and the young boys laughed.

Brown held Challenger in a gentle climb. Within a minute, trailed and flanked by a convoy of cars, vans, and photo trucks, she was 30 feet up, then 40, then 60. Still over the runway, she reached an intersection and wallowed through an awkward left turn. Then she turned again, over another runway, and began to descend. Losing its necessary sun angle, the craft became a glider drifting down for a soft landing.

The flight lasted no more than four minutes. But for a solar aircraft it was a true achievement. Brown flew a dozen or more flights that day, growing more accustomed to Challenger's characteristics and adding to the wealth of engineering data being accumulated. By the end of the day, MacCready had what he needed. With minor modifications already in mind, he ordered the Challenger crew to prepare for a series of endurance flights planned for Arizona in December.

Sun-powered Penguin

MacCready's interest in solar flight began in late 1979. "Other people had built battery-type aircraft using solar charging," he told me [PS, July '80], "but a pure solar aircraft didn't exist. It struck me as something worth doing at a time when I was very unenthusiastic about our country's dependence on Mideast oil."

The idea, then, was aimed more at sparking public awareness of solar power than at developing a practical solar airplane. "Practical?" MacCready grinned. "Challenger is like the Gossamers in that it's completely impractical, unless you want a little airplane flying around at 40,000 feet."

That altitude, and even higher, could be reached by solar-powered drones. Such craft might have some practical application in surveillance or atmospheric sampling. But MacCready isn't looking for anything more than the pursuit of new knowledge and the opportunity to spread the word about solar energy.

"If Solar Challenger helps speed up development of solar power even by six months or a year, it will have been useful in making our world more secure," he said.

MacCready recruited Du Pont as the project's sponsor. The company had been deeply involved in the human-powered flights and knew him well. The project was announced in June 1980, and fabrication of Challenger began soon afterward. In the meantime, a spare Gossamer, the Penguin, was outfitted for solar-flight testing.

A key question was how much control a pilot would have in guiding a solar-powered craft through a variety of sun-angle conditions. The answer came last August when Brown made aviation history guiding Penguin over a two-mile course at Edwards Air Force Base, Calif. With its large pusher-prop turned by a motor receiving only photovoltaic electricity, Penguin clumped along at about 16 mph, rising barely 12 feet above the desert floor.

It was one of those stirring moments in aviation. Air-to-ground communication was accomplished by Brown yelling to an outrider on a bicycle. The clumsy Penguin settled to within inches of the ground, only to be nursed back up to 10 or 12 feet through Brown's careful pilotage. Finally it touched down, bounced lightly, and landed.

MacCready was elated. The fluctuations in solar power weren't severe enough to be a hindrance. Work on Challenger could move ahead rapidly.

Sun-seeking design

Challenger resembles a normal airplane more closely than MacCready's earlier machines. It has a propeller in front, a high wing over the pilot's compartment, and a boom extending rearward to the tail sections. The wing and the horizontal stabilizer are covered with more than 16,000 high-quality silicon photovoltaic cells.

MacCready designed the wing for maximum solar exposure. Its huge chord extends nearly six feet from leading to trailing edge. But all curve in this airfoil is confined to the forward 15 percent of the wing. The rest is perfectly flat to provide the best platform for mounting and maintaining solar cells.

The wing is actually made of three sections. The main segment is parallel to the ground, while two outer pieces angle slightly upward. Gull-wing in appearance, this design captures the maximum amount of sunlight.

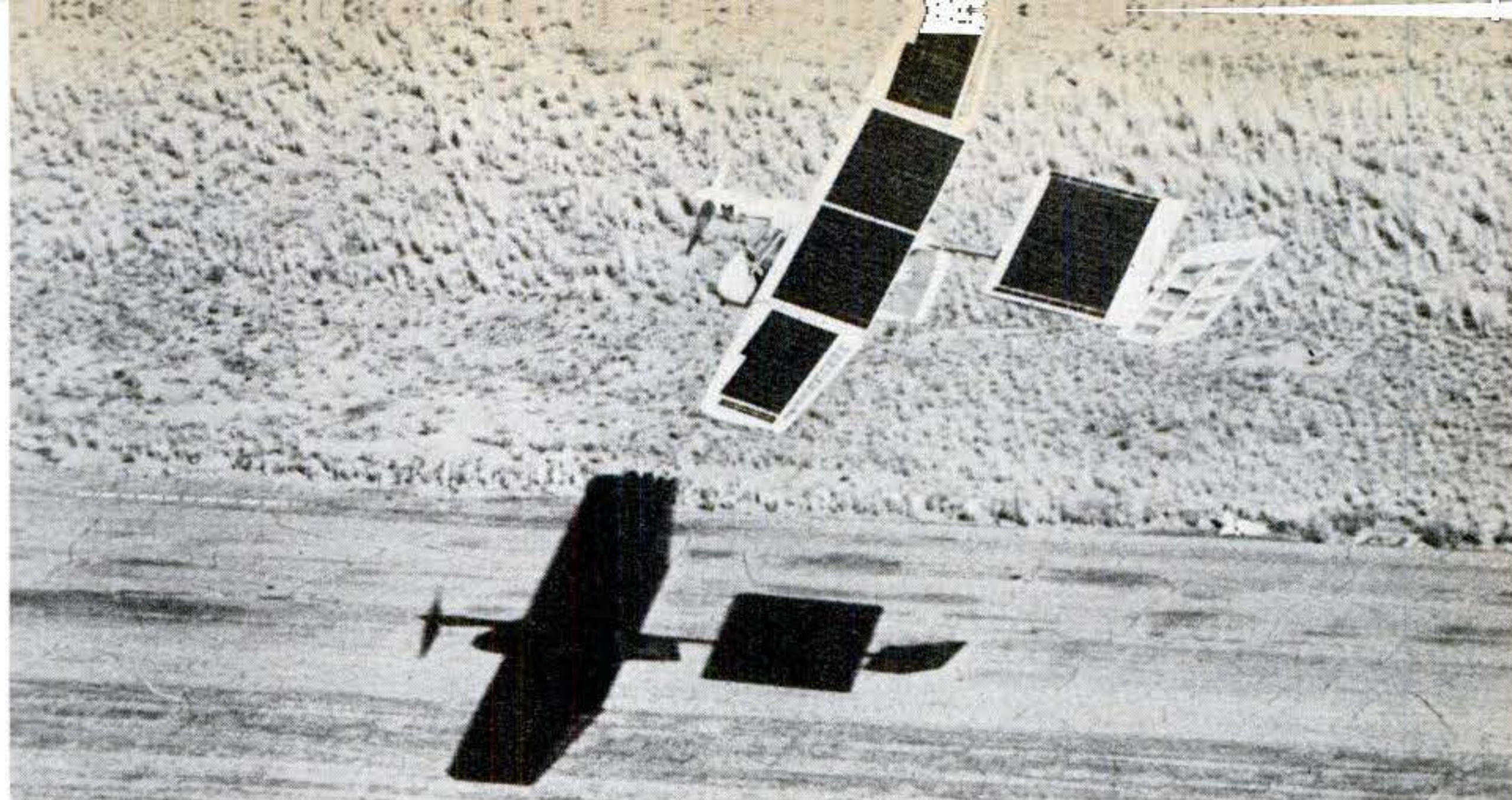
The tail is also slightly offbeat. Since the horizontal stabilizer is covered with solar cells, the vertical stabilizer



Cockpit controls are checked by test-pilot Janice Brown (above) while a colleague discusses the flight plan. Workshop preparation for flight (right) meant soldering connections between more than 100 banks of 144 solar cells; each bank is wired in series.



Blanketed with solar cells, Solar Challenger floats about 20 feet over the Mojave Desert. But Challenger has soared as high as 3,800 feet using the weak rays of the winter sun. And if the pilot carried oxygen, the plane could go 10 times as high.



can't stand in its normal position atop it. Instead the vertical stabilizer is installed aft and tilted to keep its shadow from falling on the solar cells. (They are wired in series, so if even one cell is blocked out, a whole string of 144 cells is removed from service.)

"On a good summer day this solar array will produce about three kilowatts at sea level and optimum sun angle," MacCready told me. "With a 100-pound pilot, it takes 1,300 watts to sustain level flight and every additional 100 watts gives you about 10 feet per minute in climb speed."

By carrying along oxygen, a pilot such as Brown could reach 40,000 feet, MacCready said. "The higher you go, the more efficiently the cells operate," he explained. "At

“You can make an airplane that’s much more efficient than a bird . . . It’s a whole different realm of flight. This thing flies at 20 mph and floats like a bubble”

40,000 feet you could be generating 4,800 watts, and you’d actually be storing energy as altitude.

"To get maximum range, you could climb until you ran out of sun, then go into a long glide."

Challenger has a lift-to-drag ratio of about 13.5, meaning it will glide 13.5 feet forward for every foot of altitude lost. That's much less than a sailplane's, but still respectable. From 40,000 feet it could glide more than 100 miles, depending on winds.

Weight is a critical factor for Challenger. Du Pont furnished a variety of lightweight materials—Mylar film for covering, Kevlar for wing spars, Nomex aramid paper for the honeycomb core of structural spars and control surfaces, and Delrin acetal resin for control-system pulleys. Pilot Brown even wore a Du Pont jump suit weighing just 15 ounces; it helps keep test-flight weight down.

The craft was originally designed for a gross weight of about 235 pounds, including pilot and parachute. "But the weight crept up," MacCready said. "Everything had to work the first time, so we designed in extra strength."

Challenger does have strength. It's officially stressed for six positive and four negative g's, and MacCready guesses it will safely handle 50 percent more than that. "No plane has ever been so strong while being so light," he said.

After the El Mirage test flights in November, MacCrea-

dy added an extra foot to each wing tip to give a bit more stability. He also extended the forward boom that carries prop and motor by a foot to give better clearance and control. Finally, he enlarged the stabilizers slightly. The result was an empty aircraft weighing 195 pounds—70 pounds for the power system, including gearing, solar cells, propeller, motor, and instruments; and 125 pounds for the airframe.

The motor itself was custom-built by Astroflite, a company that normally produces small motors for hobbyists.

In early December, MacCready and his team went to Marana Airpark, near Tucson. They hoped to set a number of solar-flight records, including at least one long-distance run north to Phoenix. But weather and hardware didn't cooperate. Cloudy days, thundershowers, and a balky propeller-pitch-control mechanism frustrated the crew.

"It's a marginal thing in winter, just barely able to fly," MacCready conceded. "In fact, I'm surprised that it flew so well at the low sun angles we had."

Brown was able to set some records, however. She picked up a warm updraft one day and lofted Challenger to 3,800 feet. On another day, she had climbed to about 1,000 feet when the propeller-pitch control broke, and she made a forced landing. That time it was a little rough: The plane suffered several rips in the Mylar covering and a balsa tip broke off the propeller. But Brown wasn't hurt.

MacCready solved the propeller problem by adding a brake to lock the pitch mechanism in place at the prop hub. The brake has a manual release so Brown can change pitch during flight. But by the time this fix was made, the mid-winter sun and weather had made Phoenix an unreachable dream. The team made a few more flights in January, mostly to get experience, then packed it in for the winter.

MacCready planned to install an uprated motor in Challenger by spring, then do a short series of test flights before taking on his real dream. "We're hoping to do a Paris-to-London flight in early June," he said. "Then we want to take Challenger to Geneva and attempt a 10,000-meter-altitude flight."

The ultimate goal of hammering at frontiers to promote solar power continues to dominate MacCready's life. But last January he was grinning about a more personal experience.

"I flew it myself three days ago," he told me, "and it made me really believe you can make an airplane that's much more efficient than a bird. The control was excellent."

"It's a whole different realm of flight. Here's this thing flying at 20 mph and floating like a bubble. I felt wonderful," he said.

Magnetic furnace

cooks the danger out of hazardous waste

Asbestos, contaminated soil, or nuclear waste in . . . shattered glass out

By ALAN RADDING

Technology solves problems, but sometimes it creates new ones as side effects. Now a sanitary engineer has adapted an old technology, the steel foundry, to deal with a problem that won't go away: hazardous waste. Kenneth Southwick's pyromagnetic furnace transforms any kind of solid waste into a pelletized glass matrix that can be safely stored or, in some cases, made into new products.

"In effect, we reversed the foundry process," says Southwick. "Instead of using the machine to make iron, we use the iron to transfer heat to do useful work."

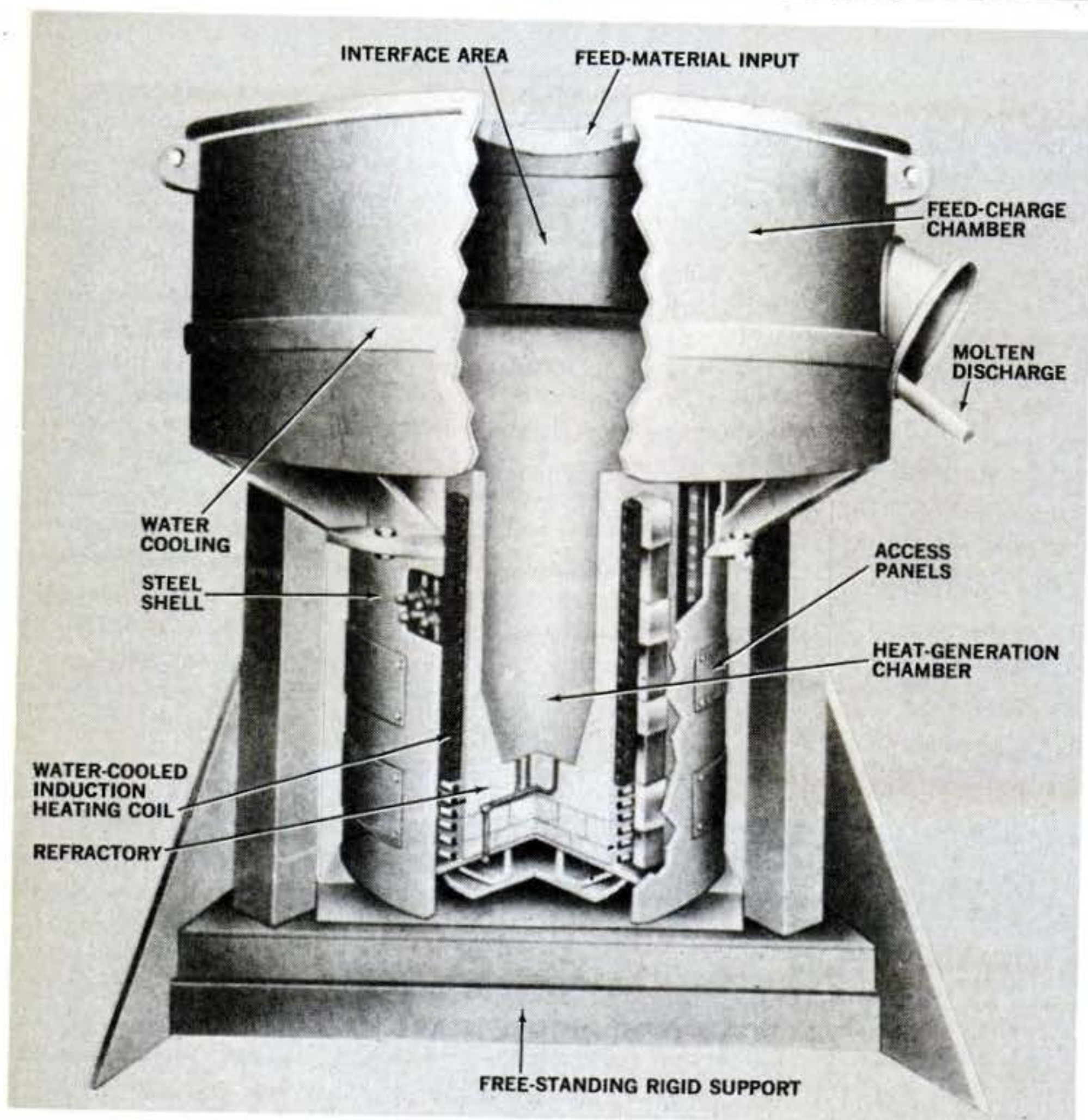
Here's how the furnace works: Electricity runs through an induction coil to melt an iron core. The iron acts as a "liquid motor," pumping energy to the top, where waste and various silica materials (rocks, slag, sand) are cooked at temperatures of up to 3,000 degrees F. The molten waste flows out of the furnace into a quench tank for sudden cooling. The end product: a solid mixture of silicates and waste that resembles shattered automobile safety glass. In this form, says Southwick, the waste is sterile, nontoxic, and chemically inert.

Unlike an incinerator, the device produces no air pollution and gives even temperatures. Because of iron's high thermal conductivity, it is 75 percent efficient compared with about 15 percent for a combustion process.

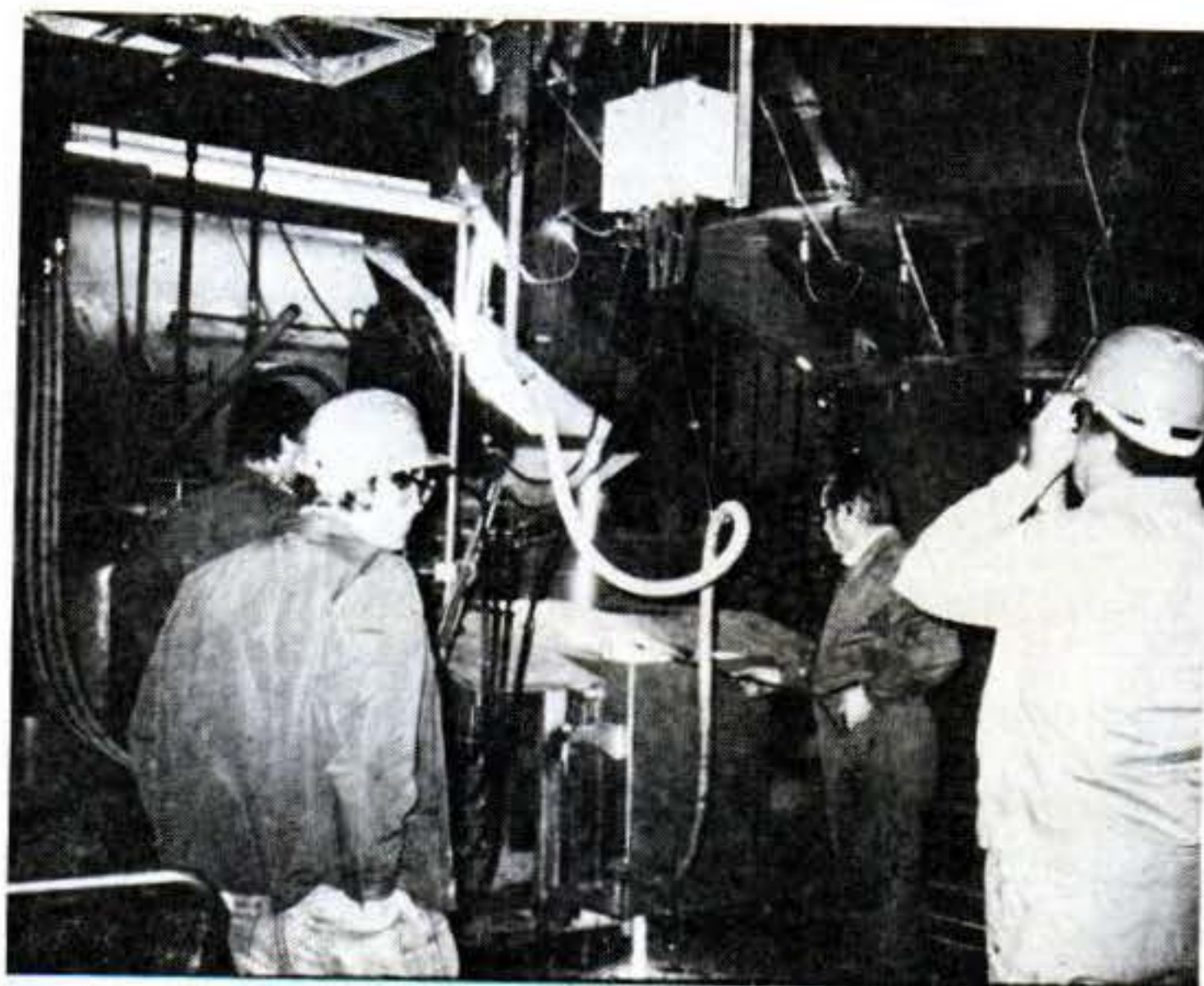
The device has EPA approval for processing asbestos, and tests are under way for chemical- and nuclear-waste treatment. Asbestos is a dangerous carcinogen in its crystalline form, but broken down into pellets it can be safely disposed of or used to make other products—road-bed material or aggregate for concrete.

Southwick is developing a portable model to handle soil contaminated with chemicals. Earth would be dug up, processed, and put back in the same hole. "Instead of moving a mountain," he says, "we would cut out the tumor and treat it." For nuclear waste, radioactive material would be mixed with glass on the molecular level so it couldn't leach out as it can with encasement techniques.

Not all applications involve dangerous wastes. The device can also be used with a spinning machine to process blast-furnace slag and other silicates into rock-wool insulation. **ES**



Reverse foundry works like a giant electromagnet. Current in coil heats iron core, which transfers energy to waste material at top. High heat breaks down molecules so waste can mix with silicates. Molten mixture overflows unit (right) into trough, which regulates flow to quench tank or spinner (at left in photo).



Garbage cruncher

uses water pressure to dispose of waste

No electricity's needed—and installation can be a do-it-yourself job

By JIM SCHEFTER

SAN DIEGO, CALIF.

A garbage-disposal unit that chews up whole walnuts, banana peels, bones, or beverage-can pop-top tabs with ease? And does it quietly? Without electricity? The claims sounded so preposterous that I visited the Wastemate Corp. here to see for myself.

In Wastemate's demonstration kitchen sink, I saw a Model 78 food/waste disposer make short and nearly silent work of those trash items and more.

"Watch this," said Leonard Spelber, company president. He tossed broken glass into the unit's maw and turned it on. The noise level went up from previous tests, but the jagged shards soon disappeared down the drain. "Now this," Spelber said, dropping a spoon into the unit. There was a soft "clunk," then silence as the disposer stopped. Spelber retrieved the spoon, undamaged.

"How often do people mess up their stainless when it falls into the disposer?" he asked. "And imagine what happens to the disposer blades spinning around and slapping metal forks or spoons. That can't happen with this unit." The reason? The disposer's stainless blades will chew up anything softer than steel. If a spoon hits the blades, the machine goes into a "short-stroke mode" until you reach in and pull it out, Spelber says.

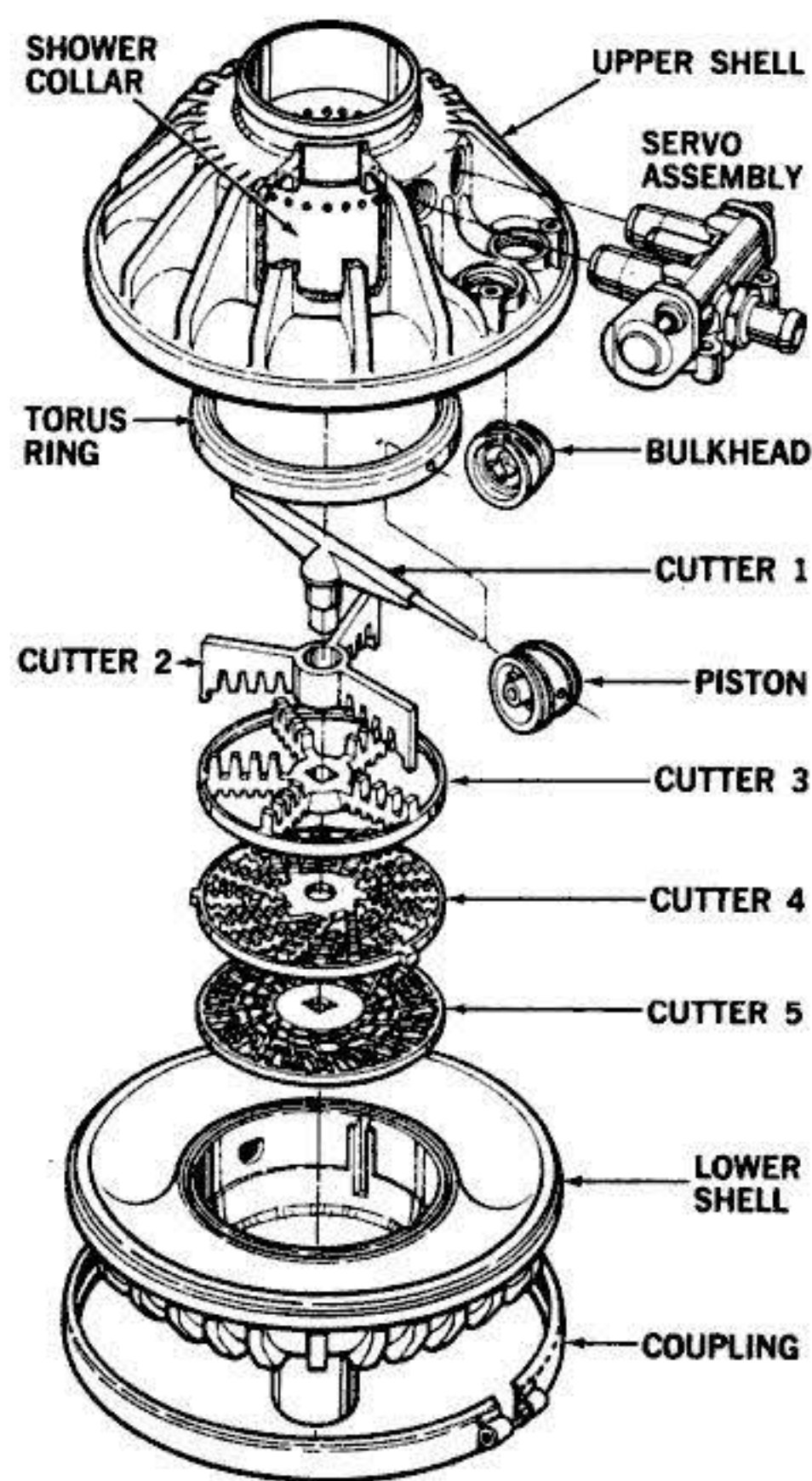
Conventional garbage disposers use noisy electric motors to spin blades at high speed while tap water flushes the effluent down your drain. They have a tough time with most bones, frequently jam with fibrous materials, can irreparably damage utensils falling into them, and sometimes throw

chunks of debris back at their users.

In addition, many states now require dedicated electrical lines and circuit breakers, plus grounding devices, during installation. That increases costs and makes do-it-yourself installation or replacement more hazardous.

Such problems don't exist with the Wastemate. Developed by Los Angeles inventor Donald Verley and now licensed to Spelber's company, the Wastemate:

- Is water-powered, using a proprietary water-servo assembly to control internal action.
- Has no electrical hookup.



Unique garbage-disposal unit uses water pressure rather than electricity to provide power. Exploded view shows the components that grind up garbage. The five cutter blades don't spin, but oscillate to crunch waste passing through.

● Uses five stainless-steel cutter blades to chop, chew, shred, and dispose of a variety of kitchen wastes.

● Can be installed easily by amateurs or professionals.

How does it work? Spelber took a unit apart to show me. "The first thing you need is about 30 pounds of water pressure," he said. "Most U.S. water systems operate at 55 psi or higher, so that's no problem."

The eight-pound disposer is housed in a 40 percent glass-polypropylene case. With an all-plastic water-servo assembly and stainless-steel blades, corrosion problems are eliminated. A threaded coupling unit makes kitchen-sink attachment simple. But it's the blades' action that makes the unit so versatile.

"The five internal disc cutters are made with decreasing teeth sizes," Spelber explained. "And only blades one, three, and five are in motion. Blades two and four are locked to the case."

Blade number one is simply a straightedge with no teeth. Number two has down-pointing teeth, which mesh with the moving, up-pointing teeth on blade number three. Numbers four and five are plate-like cutters with large numbers of teeth cast into their upper surfaces.

Because the blades are high-quality steel, not much can withstand them. But it's their motion that provides much of the unique operation.

"The blades don't spin," Spelber said. "Numbers one, three, and five oscillate through a 340-degree rotation, then back again. One cycle takes about three seconds."

That motion is provided by the water-servo assembly. When water to the unit is turned on, the servo directs it in one direction to move the blades. As the blades reach their limit, a piston hits an internal stop, which instantly reverses water flow, redirecting it to force the blades in the opposite direction.

The only sound is running water and the three-second swish-splash, swish-splash action of the blades oscillating back and forth as they chop waste materials into tiny bits.

Prototypes of the Wastemate were tested at the U.S. Naval Ship Research and Development Laboratory, and the Navy is now ordering units for shipboard installation.

"Among the materials that were successfully processed by the disposer were pork-chop bones, chicken bones, cardboard, pop-top tabs, corncocks, glass, and parts of melamine-plastic dinnerware," the Navy reported.

Wastemate production is scheduled to begin late this year.

Satellite report: Solving the mystery of **the sun's violent flares**

As the storms of fire peak, Solar Max probes how they're triggered

By STEPHEN P. MARAN

Dr. Maran is senior staff scientist of the Laboratory for Astronomy and Solar Physics at NASA's Goddard Space Flight Center, Greenbelt, Md.

She might have been a TV weatherwoman. Pointing to a stormy spot on the large map behind her, Martha Pierce warned, "This area bears watching."

The region wasn't a high-pressure system or cold front, though. It was a storm center on the sun. Pierce is a solar forecaster for the National Oceanic and Atmospheric Administration, and for much of 1980 NOAA's daily predictions of activity on the sun drew a crowd of astronomers to a cramped conference room at NASA's Goddard Space Flight Center.

The scientists needed to know where to expect the next explosion of boiling sunstuff so they could command a battery of instruments aboard a spacecraft called Solar Max to point in the right direction to record the eruption. The craft's main aim was to

observe violent events on the sun—flares, erupting prominences, and coronal transients—over the course of a year that promised fireworks of such activity. During 1980, the sun would be at the peak of its 11-year sunspot cycle.

The craft's full name is the Solar Maximum Mission satellite. Orbiting 574 kilometers above Earth, it's the most advanced sun-watching satellite ever launched. From February of last year until December 11, when a series of blown fuses left its pointing system disabled, it collected unprecedented data that will enable astronomers to fathom the processes that trigger violent events on the sun.

The sun-Earth connection

Our neighboring star harbors many mysteries. Recent theories suggest that its output may not be constant, and that its girth may even be shrinking. It has long been known that the sun observes an 11-year cycle, but the mechanism that causes it is a riddle. Also, little is known about the fusion process that powers the sun, or how its outer atmosphere is heated to more than a million degrees.

These subjects are of obvious vital interest to us on Earth. The sun's out-

put determines our climate and may even affect specific weather patterns. Some of the debris released during violent eruptions strikes our planet—causing auroral displays, radio disturbances, and even electrical blowouts ["Science Newsfront," this issue]. And if we understood how the sun confines hot plasma, we might sooner harness fusion energy on Earth.

The key to solving some of the mysteries lies in understanding the sun's magnetic properties. At the beginning of its cycle the sun has a weak magnetic field generated by flowing streams of electrically charged particles. But because it is a gaseous body, different areas on the sun's surface and within its depth rotate at different speeds. As a result, the magnetic lines of force get wrapped around the sphere in tangled spirals beneath the surface. Sometimes these lines pop through the surface and cause sunspots. As the cycle progresses, the spirals become tighter and the spots migrate closer to the equator.

When a line of magnetic force arches above the surface from one spot to another, hot plasma can get trapped inside. A structure like this is called a magnetic loop. A loop stores tremen-

Continued

Minute by minute, the anatomy of a flare



20:20:01



20:22:01



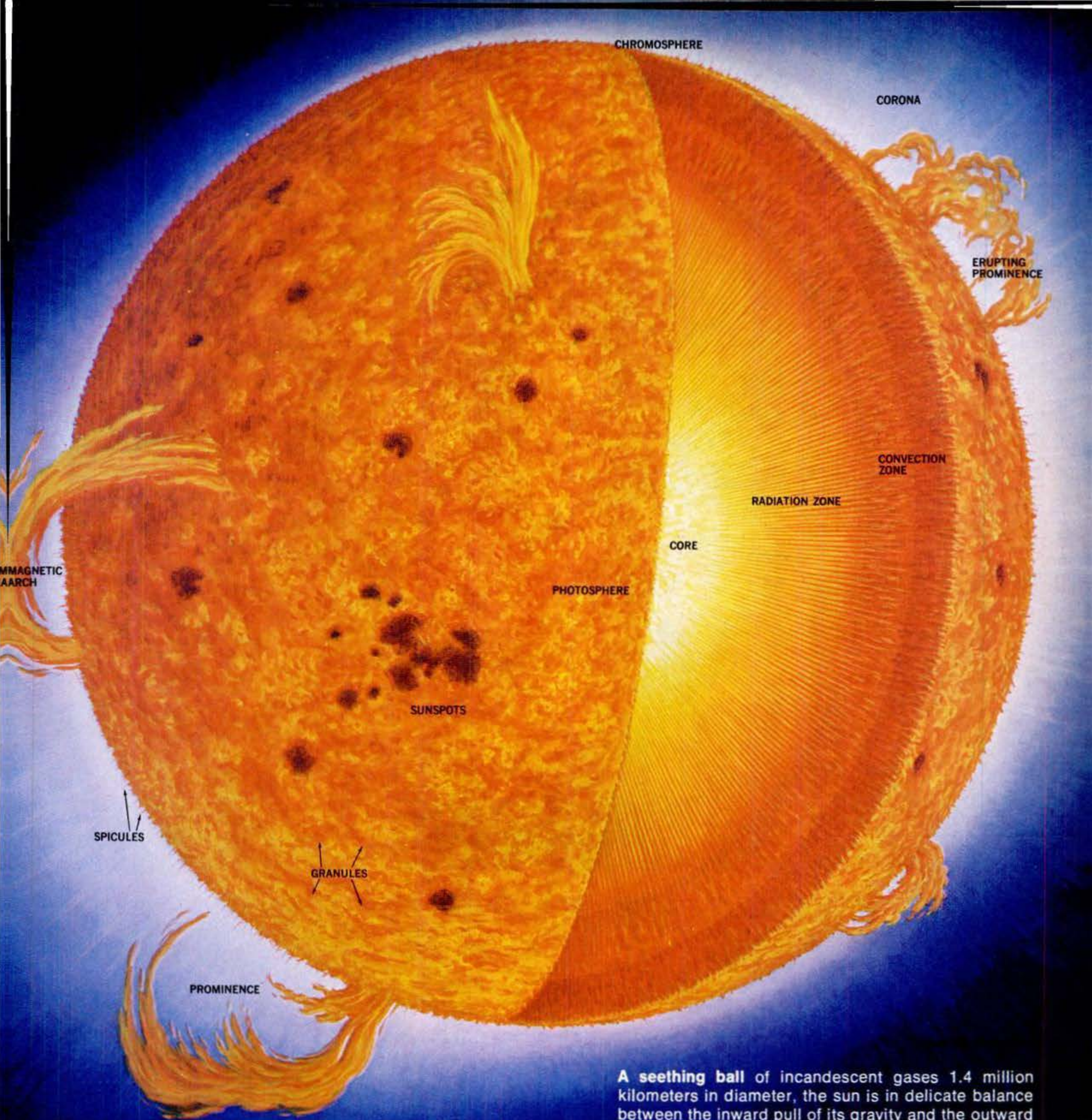
20:23:01



20:25:01



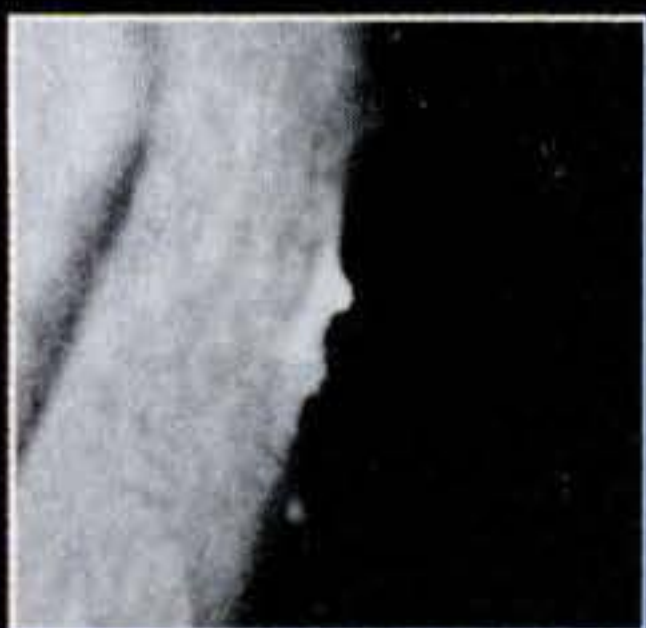
20:26:01



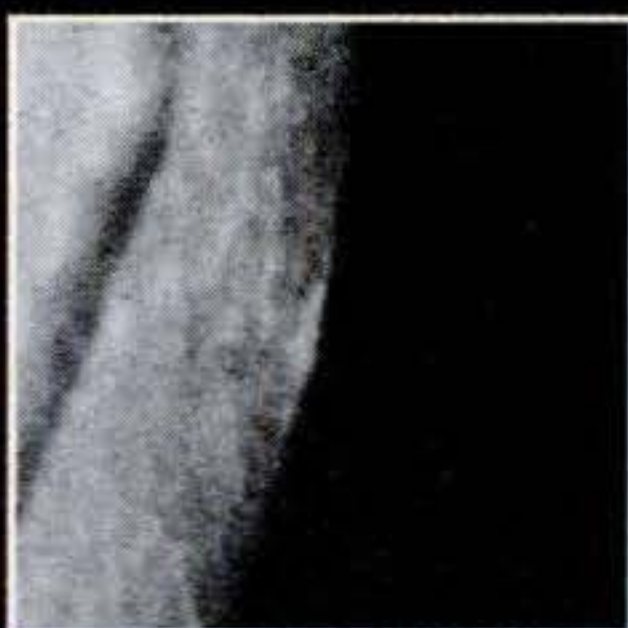
A seething ball of incandescent gases 1.4 million kilometers in diameter, the sun is in delicate balance between the inward pull of its gravity and the outward pressure of its radiation. At the core is a great nuclear furnace with temperatures of up to 15 million Kelvin. There, for the past five billion years, hydrogen has been fusing into helium, steadily producing 380 trillion trillion watts. This energy travels outward in the form of photons through the surrounding *radiation zone*. Above that level, in the *convection zone*, heat is transferred in cycling vertical currents like bubbles rising in a boiling kettle. *Granules* on the *photosphere*, the visible surface of the sun, are the tops of convective gas bubbles. *Sunspots* form on the photosphere, apparently caused by magnetic fields arising in the convection zone. These fields also control the shapes of the *spicules*, *prominences*, *arches*, and other structures that rise above the surface. The sun's temperature reaches a low point of 4,300 K in the outer photosphere. From that level outward the temperature rises dramatically. Between the *chromosphere* and the lower *corona*, a transition zone extending only about 1,000 kilometers, temperature rises from 25,000 to 500,000 K. The upper corona is three times hotter.



20:31:01

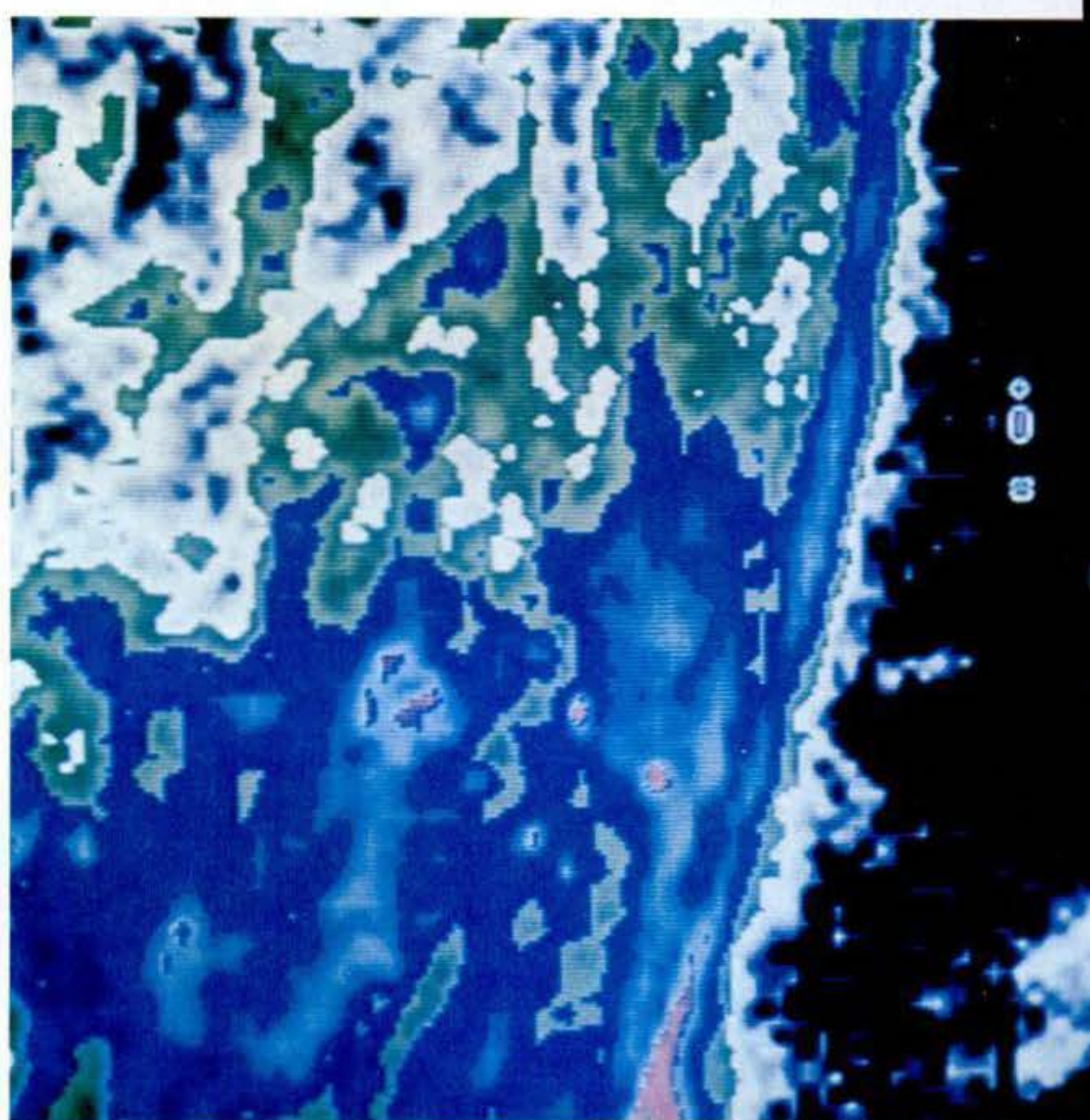
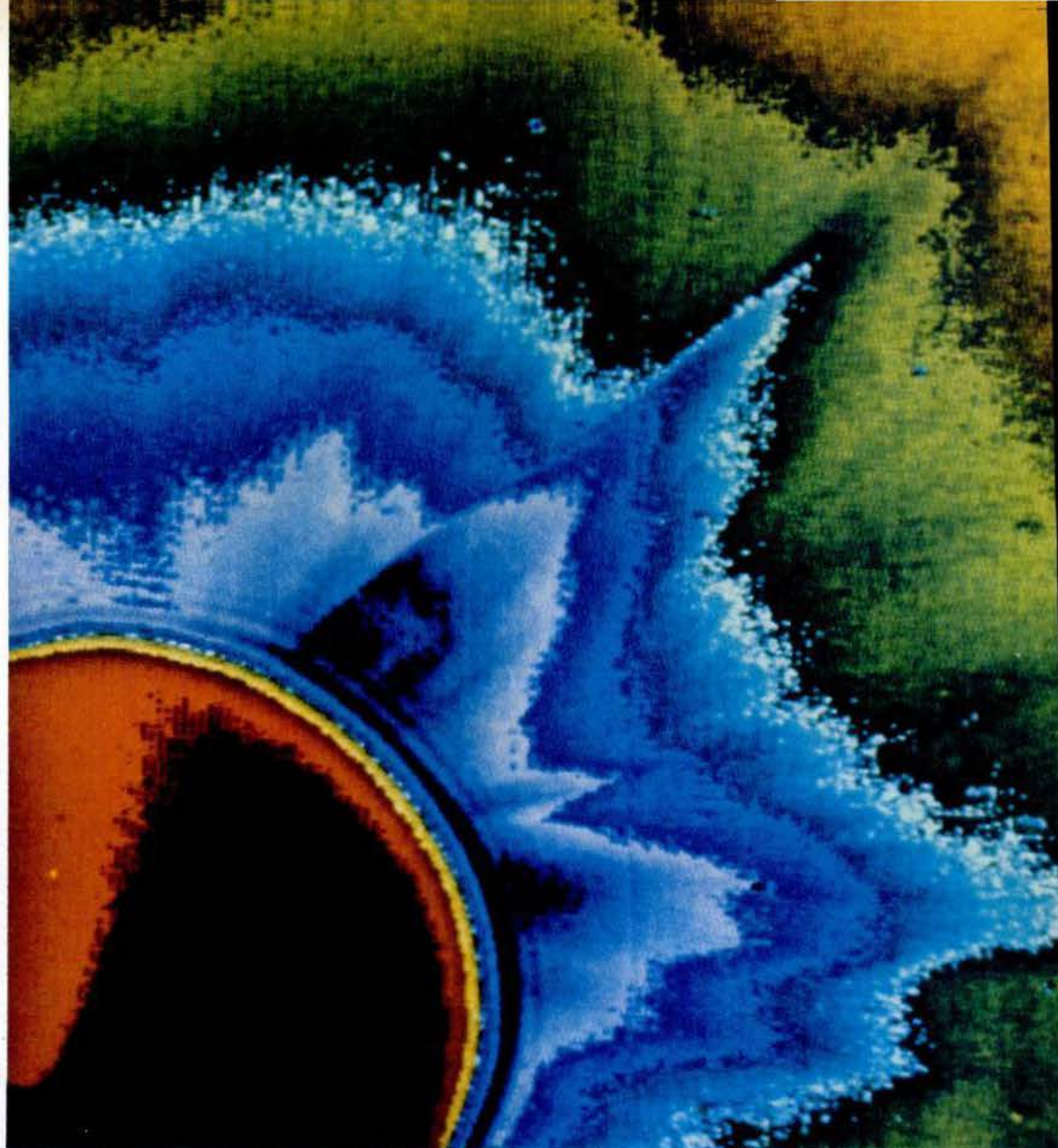
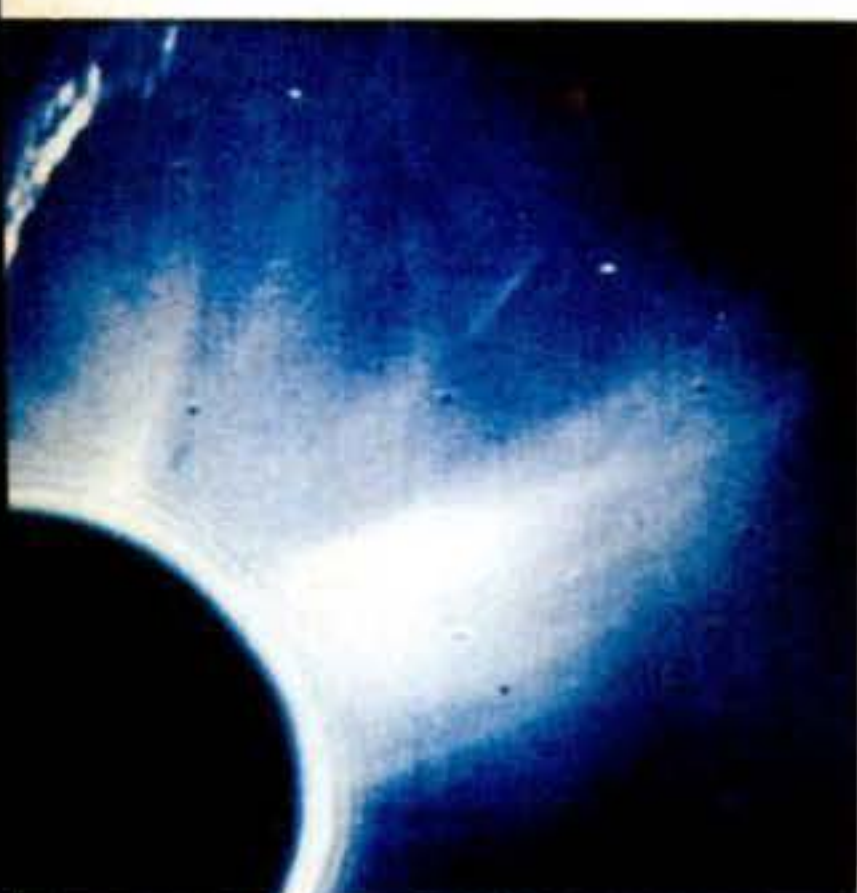


20:36:01



22:16:07

Portraits of a violent sun: Color-enhanced view of the solar corona at right shows a streamer of hot magnetized gases (darker colors represent denser concentrations). Such streamers can extend more than a million miles beyond the sun's surface. Eruption pictured below is a coronal transient photographed by satellite's coronagraph. Close-up view (bottom left), taken in the red light of hydrogen, shows that the loop remained relatively cool, magnetically insulated from the hot corona. Bottom right: ultraviolet image of a flare. Part of the loop is still recognizable as it opens and rises.



dous amounts of energy when flowing gases twist it and bubbling convection motions shake it from below. When the stored energy builds up to a critical level, a flare occurs—what plasma physicist Jim Ionson calls “a solar short circuit.” In a large solar flare, as much energy is released in a few minutes as the U.S. would use at present rates in 120,000 years—most of it in the first 30 seconds.

Kenneth Frost, Solar Max project scientist, summed up the principal problem: “How is that much energy gathered and stored so it can be released in such a short time?”

To find the answer, scientists need to know what happens in a loop just prior to a flare. But the best previous data, supplied by the now-fallen Skylab, covered only the decay phase of the eruption. “An astronaut would see a flare happening and then point an instrument at it,” said astrophysicist Bruce Woodgate.

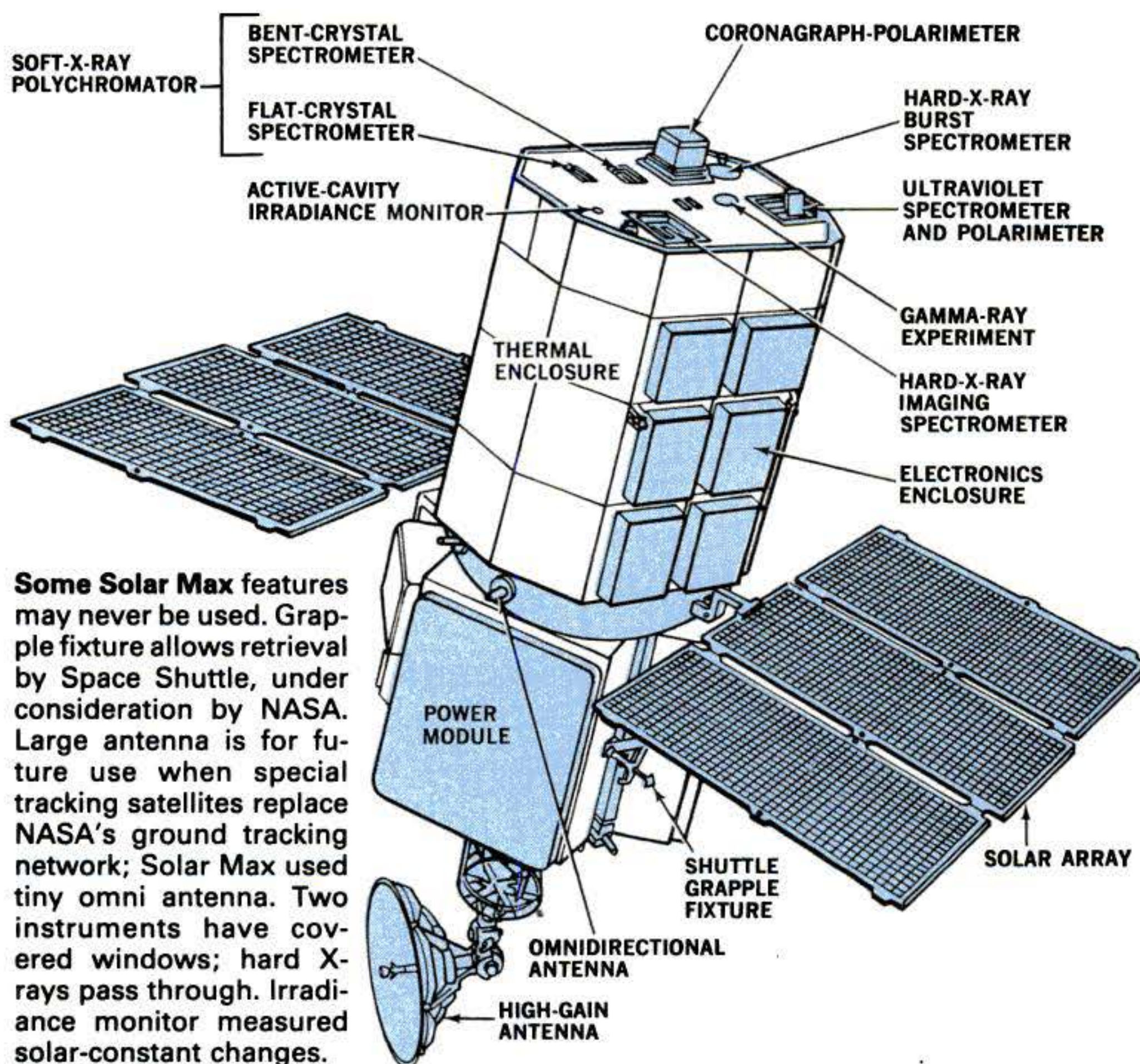
In contrast, Solar Max’s seven instruments continuously scanned active regions, and they could be reprogrammed on short notice according to ground decisions based on solar forecasts. Sometimes the planners were bypassed when decisions were made by microprocessors on board that recognized the start of a flare.

The instruments covered a wide range of the electromagnetic spectrum—visible light, ultraviolet radiation, low- and high-energy X-rays, and super-energetic gamma rays. Each viewed events through different-colored glasses to provide a complete picture.

The flow of plasma within a loop was monitored by the ultraviolet spectrometer, which produced maps of velocity patterns by measuring the shifts of spectral lines of certain signature atoms. The first hint of a flare was often detected by a soft-X-ray (low energy) instrument that detected the characteristic brightening of plasma as it heated up. A hard-X-ray imager searched for similar clues, monitoring up to 80 billion square kilometers at a time and forming fresh images every 1½ seconds. Either of these devices could alert other instruments that a flare had begun, and where.

Most of a flare’s tremendous energy is released in an abrupt burst of hard X-rays at the beginning of the event. These spike bursts were recorded by a burst spectrometer, which measured intensity changes every 100 milliseconds. Finally, material ejected from a flare was monitored as it passed through the solar corona (the faint outer atmosphere) by an instrument called a coronagraph-polarimeter. A coronagraph uses a small disc to

Seven eyes on the sun



Some Solar Max features may never be used. Grapple fixture allows retrieval by Space Shuttle, under consideration by NASA. Large antenna is for future use when special tracking satellites replace NASA's ground tracking network; Solar Max used tiny omni antenna. Two instruments have covered windows; hard X-rays pass through. Irradiance monitor measured solar-constant changes.

block the blinding solar surface and render the corona visible.

During the 10 months of full operation, these instruments recorded data on about 2,000 flares. One early spectacular explosion helped to explain the mechanics of flares. This occurred on March 29, 1980—producing the largest spike burst ever recorded. The burst spectrometer graphed a detailed time history of the burst, showing—to the surprise of experimenters—that it did not appear in a single spike but in steps that built to a peak. This suggested that the flare did not happen instantaneously but rather as a series of events.

Conflicting theories

There are several possible explanations for this. According to one theory, a flare occurs when a twisted magnetic loop is suddenly disrupted and its magnetic lines realign in a simpler configuration. Such a reconnection would accelerate charged particles to high speeds. These would strike atoms in the solar gas and produce hard X-rays. Solar physicist Stirling Colgate suggests that a flare starts when parts of a loop are kinked and break up rapidly into “a series of sausages,” causing multiple reconnection events.

An alternative theory holds that flares are set off when two distinct loops approach one another, or even touch. For example, a new loop may

emerge from below the sun’s surface and rise toward an older one that has already been fully stressed by twisting and shaking. So the March 29 event may have been triggered when one disrupted loop infected an adjacent one, which set off another, and so on—a magnetic wildfire. As each loop erupted an additional step was recorded by the burst spectrometer.

Data from other flares suggest that either mechanism can trigger a flare. On April 30, the ultraviolet spectrometer was making a series of images of hot gases filling up a magnetic loop—arching from one sunspot toward the loop top 11,000 kilometers above. Suddenly, the plasma brightened and the burst spectrometer recorded a spike.

Correlating these images with earlier pictures, astronomers discovered that there was another loop overlying the first. This loop brightened markedly as the lower loop rose upward and seemingly broke into it. After the flare, the upper loop remained in view while the lower one disappeared. Apparently the flare was caused by one loop striking another. However, it’s also possible that the lower loop erupted on its own.

Measurements by the soft-X-ray instrument tend to confirm the reconnection theory. These show that the spectral lines representing the types and amounts of ions in the plasma got

[Continued on page 120]

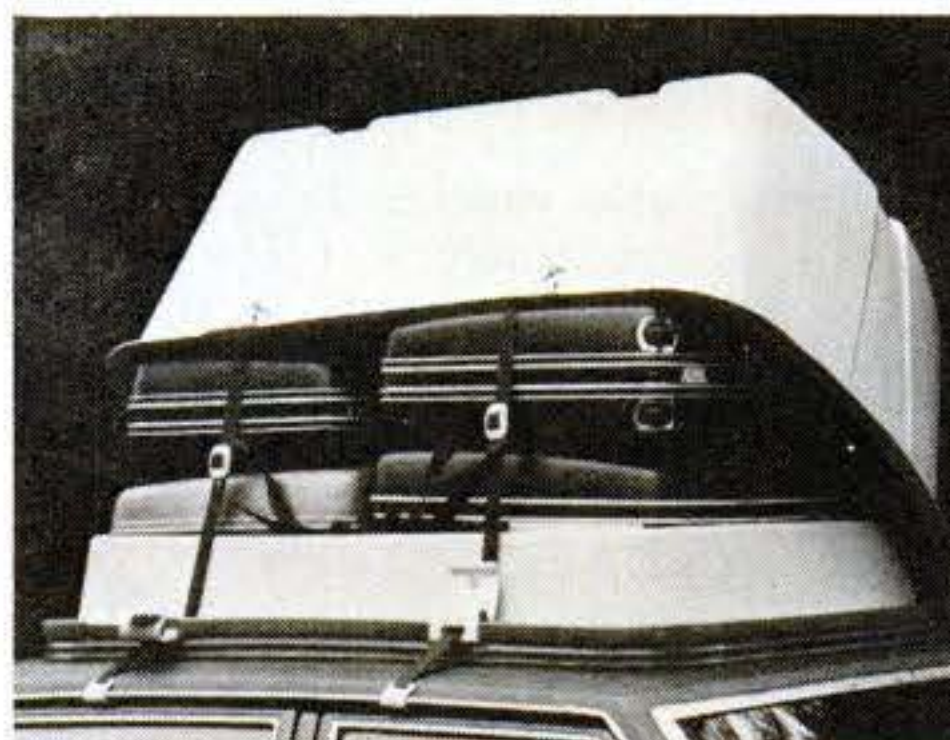
Compact cargo carriers

for today's smaller cars



Nearly symmetrical halves and an upright, basically boxy shape characterize

most clamshell-type carriers. Kar Rite's model 963 costs \$69.95, including locks.



Multi-purpose Echo Caddy 8000 can be a clamshell carrier (above), or the base can be used as either a basket or support for outsize cargo (left). It costs \$240.

Clever, versatile, and aerodynamic new carrying systems are updating the old standards

By ED JACOBS

The trend toward improved fuel economy has us buying smaller, more fuel-efficient cars. One unfortunate result of this is that we're no longer getting the cargo-carrying capacities we've gotten used to.

For that, many car owners are turning to small trailers or external cargo carriers. To meet the new demand, manufacturers have introduced clever new carrying systems for rooftops and trunks, as well as compact and efficient trailers.

These new-generation trailers have impact-resistant shells of fiberglass or molded plastic carefully shaped to lessen fuel-wasting aerodynamic drag. At the same time, they are laid out to give you the most usable space within their sleeker contours. You can even build your own trailer from a kit containing anything from just the bare essentials to a complete package with all accessories.

External carriers can be mounted on either trunk or roof, depending on your vehicle and needs. There are three basic types: bar, basket, and clamshell (plus dedicated carriers for bicycles, skis, and so on, too specialized to be discussed here).

Bar-type carriers are the simplest: basically just two narrow poles or racks laid across your car's roof. They're great for lashing down canoes and other outsize cargo, but they're not much help with luggage or small objects.

Continued



Irresistible antiques at roadside? Amco's Magic-Rak carrier system (\$52-\$80) uses permanent roof- or trunk-mounted tracks and optional, interchangeable components to handle bikes, skis, luggage, and other large items that won't fit inside.



Basket-type carriers generally have perimeter rails to restrict cargo movement and accept tie-downs. Kar Rite's model 749 is \$20.



Low, aerodynamic contours of A.E. Systems' Roof Rider are said to cut fuel consumption and wind whistle. Price: \$350.



Drag-reducing shapes are important in small trailer's design, too. Ebbtide Corp.'s

Basket types generally have slat floors and surrounding rails to limit cargo movement. They're good with luggage and compact, regularly shaped items. But they offer no weather protection. Some of the more rugged ones can even double as bar-types, with big items lashed to their top rails, if you observe loading limits.

Clamshell carriers look like their namesakes. They usually have two

Slipstream, carpeted inside, holds 30 cu. ft. and is rated for an 850-lb. load. The

roughly similar halves, and their tops swing open or come off for loading. They offer weather protection and are best for luggage and small objects, but normally cannot handle outside, bar-carrier-type loads.

Most external carriers attach by hooks and straps to the rain gutters along the roof of your vehicle or to the edges of the trunk lid. Most rest on suction cups or on protective feet so

trailer's top is removable for yard work or general-purpose hauling. Price: \$850.

they won't mar your car's paint.

Versatility is an important aspect to look for. As has been noted, many of the roof-and-trunk-mounted carriers can vary their capabilities. So can the new generation of trailers. Many of them can be converted to utility hauling or yard work simply by removing the top. Some have accessories to adapt them to other uses.

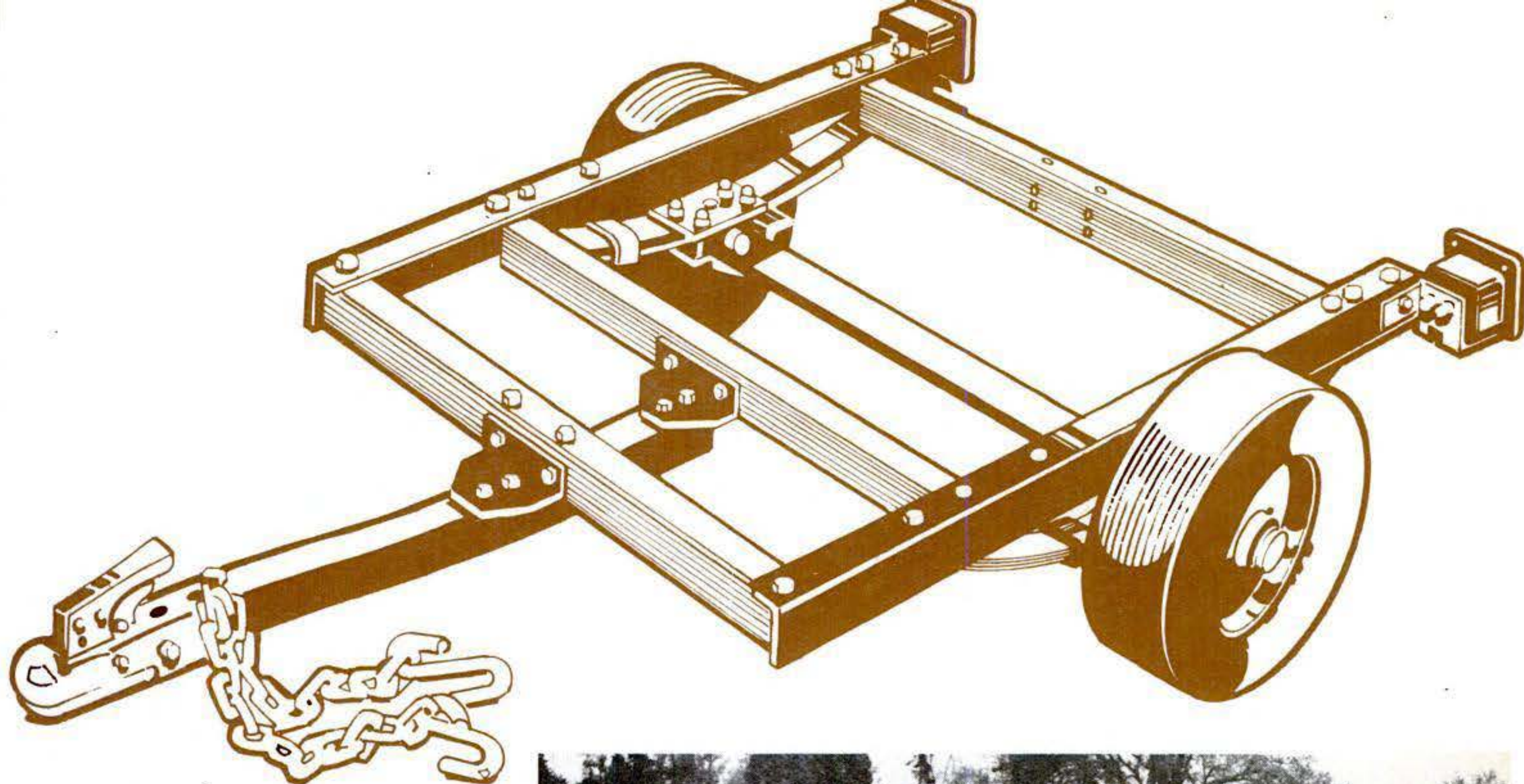
Many of the external carriers



Coleman's Versa Trailer handles odd jobs and hauling chores. It holds 36 cu. ft. with its top in place (not shown), costs \$429.

The Roadrunner, from Creative Energy Systems, can be towed by cars, RV's, or motorcycles, and can haul 840 lbs. Price: \$795.





Do-it-yourself trailer kits, such as Pro-Sport's 1,000-lb. capacity You'll Haul It (\$194.95), can be adapted for utility use or for hauling motorcycles or luggage.

Unique, single-swiveling-wheel design and dual-hitch arrangement of Echo's Gem-Tote trailer (\$595) are claimed to eliminate the possibility of jackknifing while backing up.

shown here are also available under various private brand names at auto-parts stores and department or discount stores.

Here are a few cautions when using carriers or trailers:

- Don't overload. You can easily damage your vehicle or induce uncontrollable handling characteristics.

- Remove any carrier when it's not in use. You'll pay a steep fuel-economy penalty if you don't.

- Read and heed the manufacturer's instructions, as well as those of your vehicle's manufacturer.

Add a dash of common sense, and you'll enjoy safe hauling. **E 5**

MANUFACTURERS' ADDRESSES

Compact trailers:

Bremen Sport Equipment, Inc., Box 175, Bremen IN 46506; **Coleman Co., Inc.**, 250 N. St. Francis, Wichita KS 67201; **Creative Energy Concepts, Inc.**, 505 W. Allen Ave., San Dimas CA 91773 (Roadrunner trailers); **Echo Carriers, Inc.**, Box 2006, Holland MI 49423; **Robert P. French Co.**, Space Accessories Div., 130 W. Wieuca Rd. N.E., Atlanta GA 30342 (Ebbtide Slipstream trailers); **Pro-Sports, Inc.**, 385 24th St., Suite 216, Ogden UT 84401; **Sears, Roebuck and Co.**, Sears Tower, Chicago IL 60684.

Rooftop and trunk-mounted carriers:

A & E Systems, Inc., 3100 Segerstrom, Santa Ana CA 92704; **Amco Manufacturing Corp.**, 7425 Fulton Ave., N. Hollywood CA 91605; **Echo Carriers, Inc.** (see above); **JCPenney**, 1301 Avenue of the Americas, New York NY 10019; **Kar Rite Corp.**, 3737 N. Acorn Ave., Franklin Park IL 60131; **Montgomery Ward**, Montgomery Ward Plaza, Chicago IL 60671; **Sears, Roebuck and Co.** (see above); **Western Auto Supply Co.**, 201 W. Grand, Kansas City MO 64108; **J.C. Whitney & Co.**, 1900-24 S. State St., Chicago IL 60680.



Bremen's Travel EZ fiberglass trailer can hold up to 800 lbs. and 49 cu. ft. of cargo.

Its top is front-pivoted to prevent accidental fly-open while being towed. It's \$799.

The computer revolution in shortwave receivers



Push a button and you get the world. Did you expect less for \$3,800?

By **WILLIAM J. HAWKINS**
PHOTO BY JOHN KEATING

When President Nixon, aboard Air Force One, spoke by phone to an aide telling him not to release the Watergate tapes, Michael Gurdus heard him say it. When the hostage-rescue attempt failed in Iran, Gurdus was the first civilian to know what had happened. But both times Gurdus was at home—in Tel Aviv, Israel—and never left his apartment to learn the news. His secret is no crystal ball, no hot line to the White House. Gurdus, a jour-

nalist credited with numerous scoops of this kind, monitors shortwave radio as a tool of his trade.

The popularity of shortwave-radio listening has increased dramatically in the past year. This is perhaps partly due to our concern with world situations, but the big reason may be technology: Receivers have become smaller, easier to use, and less expensive. And—the biggest change—they now have microprocessors—tiny computers on a chip. Push a button and you're instantly tuned to the Voice of America. Push another and Radio Moscow may present a different point of view. Still another button has Big Ben echoing in your living room from the BBC in London.

Luckily, microprocessors don't take

the fun out of DX'ing—long-range listening. You can still scan the three- to 30-MHz frequencies as you like. They simply make things easier for you: They control digital displays that show the precise frequency of the broadcast. They allow you to select a frequency directly from a keyboard and then store the numbers in a memory, to be recalled for instant tuning at the push of a button. And they'll automatically search up or down the bands for interesting broadcasts.

There are a number of radios with digital display or even with memory circuits, but only two, the Panasonic RF-9000 and the Sony ICF-2001, have microprocessor control. They're not cheap—the Sony costs \$330 and the Panasonic is a whopping \$3,800—but



from what I found, they literally give you the world in return.

The receivers

Except for the antenna, the Sony ICF-2001 (at left in photo) looks more like a desk-top calculator than a multi-band radio. It's nearly all push-button controlled. Three buttons let you manually tune up or down the band at two different speeds, or push a SCAN button and the radio will do it for you.

Instant tuning is available, too—in two different ways. A 10-button keyboard lets you enter any specific frequency directly. If you wish, you can also enter the numbers in a six-station memory bank for use later. At any time, you can recall the frequency at the push of a button.

A digital display continually updates to show the frequency. And, since shortwave listening is basically a nocturnal sport, there's even a sleep switch (like the one on a clock radio) that automatically turns the radio off at a preset time.

The Panasonic RF-9000 has a carrying handle, but at 44 pounds it is not really very portable. And with 91 buttons, five knobs, two digital displays, and two meters, it's far from just a receiver. Its microprocessor controls every function of this radio—including turning it on and off at specific times on certain days of the week. (An auxiliary tape-control jack starts a recorder, too, if you're not home.)

There are four different ways you can tune in a station: The large man-

ual tuning knob lets you sift through the bands at your own pace. A direct-access tuning keyboard lets you punch in any specific frequency. A 16-channel memory stores any frequency for instant recall later. And a row of buttons under the electronic slide-rule dial (LED's illuminate up and down the scale as you tune) puts you in any band at a push. Through all of this, a digital display shows the exact frequency.

The tuning can be done in 100- to 500-Hz steps or in one- to five-kHz steps. Separate buttons let you choose. Now add controls for upper or lower sideband, noise limiting, and RF gain; a digital display for the time, day, and date; a signal-strength meter; and an FM-tuning indicator—and the instruction manual for the RF-9000 will become the best-read book in your home. (The manual, by the way, is about the size of the Sony receiver.)

What you'll hear

Shortwave broadcasts can skip, or jump, halfway around the world by bouncing off the ionosphere. That makes all of the nearly 4,500 broadcasts from some 34 countries meat for your listening palate. World news, sports, ship-to-shore communications, music, drama—voices speaking in nearly 150 languages from Bombay to Brussels entertain and inform you.

"You get to recognize sounds, too," says Bruce Kampe, an editor for *QST*, a popular magazine for ham-radio buffs. "One we call 'the woodpecker.' As it turns out, it's actually the USSR's over-the-horizon radar."

Some sounds are not understood. In one transmission, a female voice repeats numbers in various languages, over and over. "The general public has no idea of what they mean or how they're used," Kampe added. (The rumor among DX'ers is that these are coded spy messages!)

And in some cases, the newest sounds are simply static: The Russians have begun jamming, after a seven-year halt, because of negative reports over Western stations about the crisis in Poland.

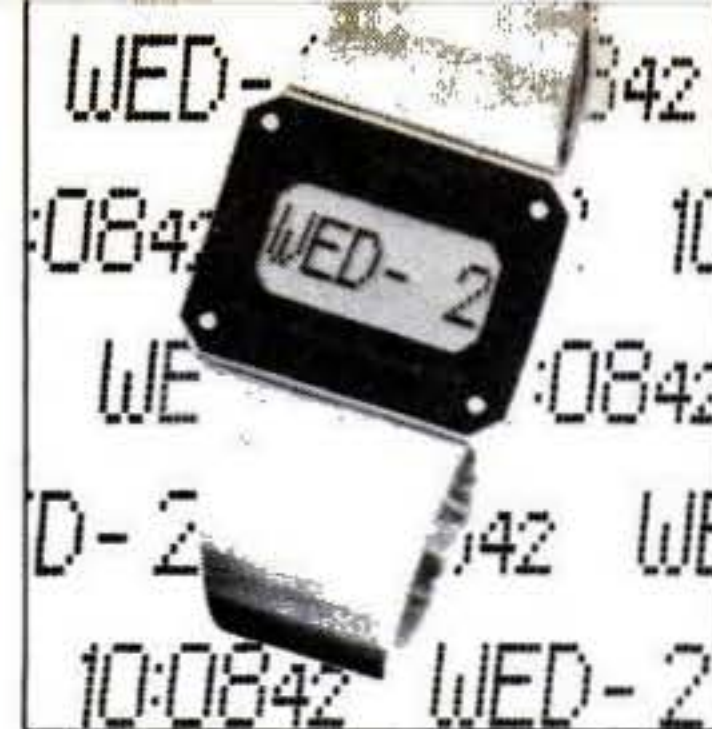
But all this—even static—offers you information unavailable through conventional local radio broadcasts. As Kampe put it, "Shortwave listening gives you an education. It's the barometer of the world."

It's impossible to name even a fraction of the international broadcasts available now. But if you'd like to see a list, try reading the *World Radio-TV Handbook*. It's available in bookstores or from Gilfer Associates, Inc., Box 239, Park Ridge, N.J. 07656. It costs about \$15.

53

What's New

A PICTURE ROUNDUP OF NEW PRODUCTS AND DEVELOPMENTS



Scrolling watch

Push a button on Seiko's \$195 LB series watch, and day and date appear—in a choice of five languages. Two seconds later the big alphanumeric readouts move slowly left and are replaced by the time. The new model has a liquid-crystal display composed of tiny dots.

Bike locker

Bikes or mopeds being stolen? Cycle Safe is a modular locker system for protection against thefts, vandalism, and weather. Each locker, made with fiberglass-reinforced plastic, holds two cycles. Philip Johnson Corp. (Grand Rapids, Mich.) makes them.



Noise killer

Fist-size pyramids made with sound-absorbing acoustical foam can minimize noise in rooms by trapping sound, says Illbruck/usa (3800 Washington Ave. N., Minneapolis, Minn. 55412). Sonex Pyramids come in colored 48-by-48-in. sheets, three or four inches thick.



Swing bridge

A counterbalanced swing bridge in Hull, England, swivels on a 13-ft.-diameter roller-bearing ring. There's an off-center pivot near the base for support. Hydraulic rams can open and close the six-lane bridge in less than 2½ minutes. The deck is 273 ft. long.



Dream jet

Executives in a hurry will cruise at 1,200 mph in the Gates Learjet business machine—in the year 2000. The concept model shows forward-swept wings, winglets, and canard, planned for the 10-passenger dream jet. Range: 4,000 miles. Price: perhaps \$15 million.



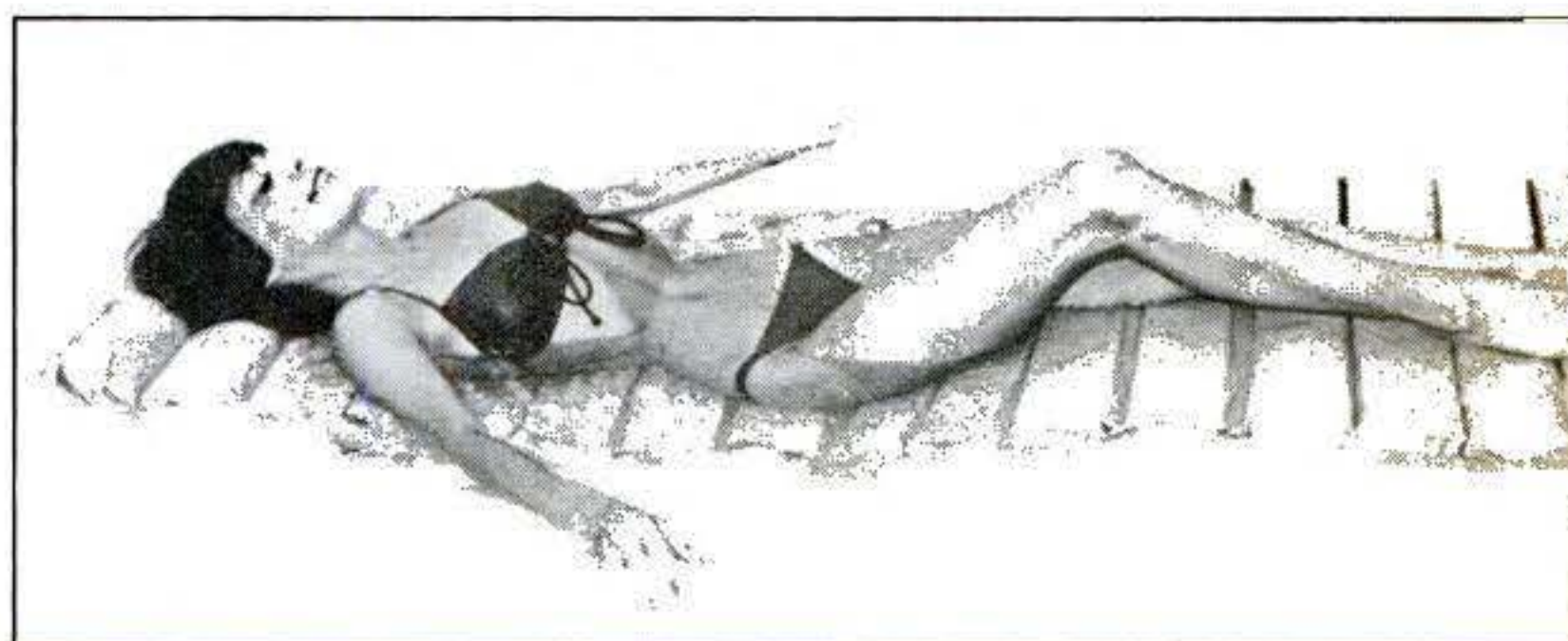


Super chopper

It's 42 percent lighter, 50 percent smaller, and requires 41 percent less power than previous CH-53 series machines, says Sikorsky of its "E" Super Stallion helicopter. The computerized, triple-turbine, seven-blade Navy chopper can lift 16 tons over 50 miles.

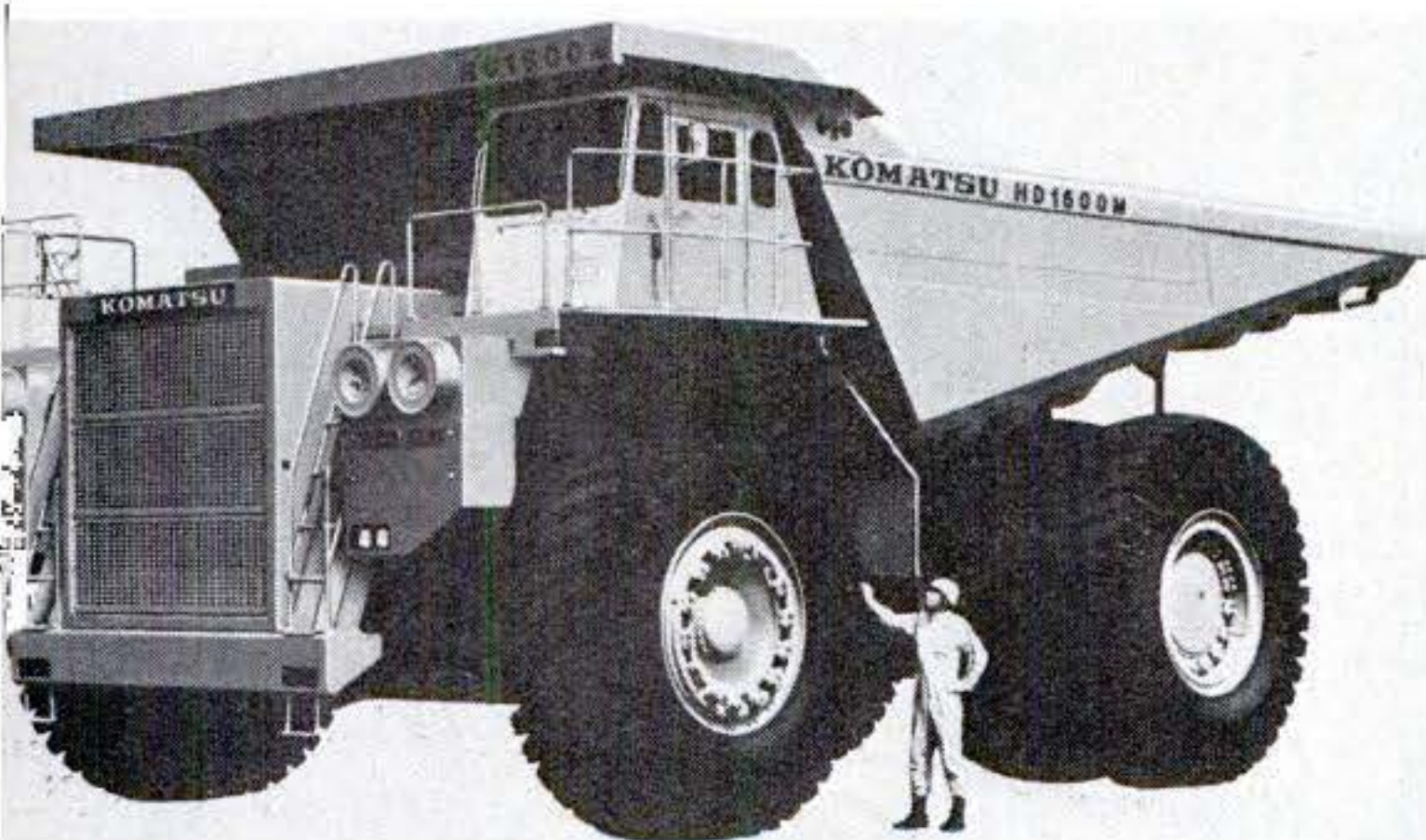
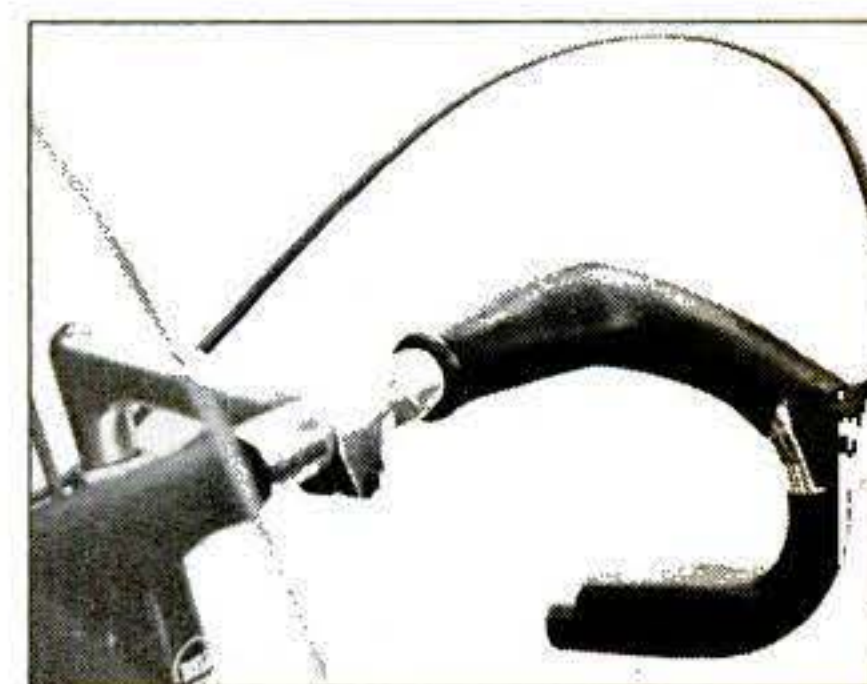
Low-cost float

Flex Float won't sink if punctured because the mattress is made with 16 planks of encapsulated foam. The 24-by-72-in. mattress weighs 3 1/3 lbs. and rolls up for storage. Price: \$12.95. Electro Foam Corp., Box 645, Sallisaw, Okla. 74955.



Bike grip

Hands sore after gripping the handlebars on your bike? Morgan grips have a built-in, ribbed shock-absorption system to cushion you from road vibrations, says Morgan Concepts (Box 302, Coeur d'Alene, Idaho 83814). Price at dealers is about \$15.



Giant dumper

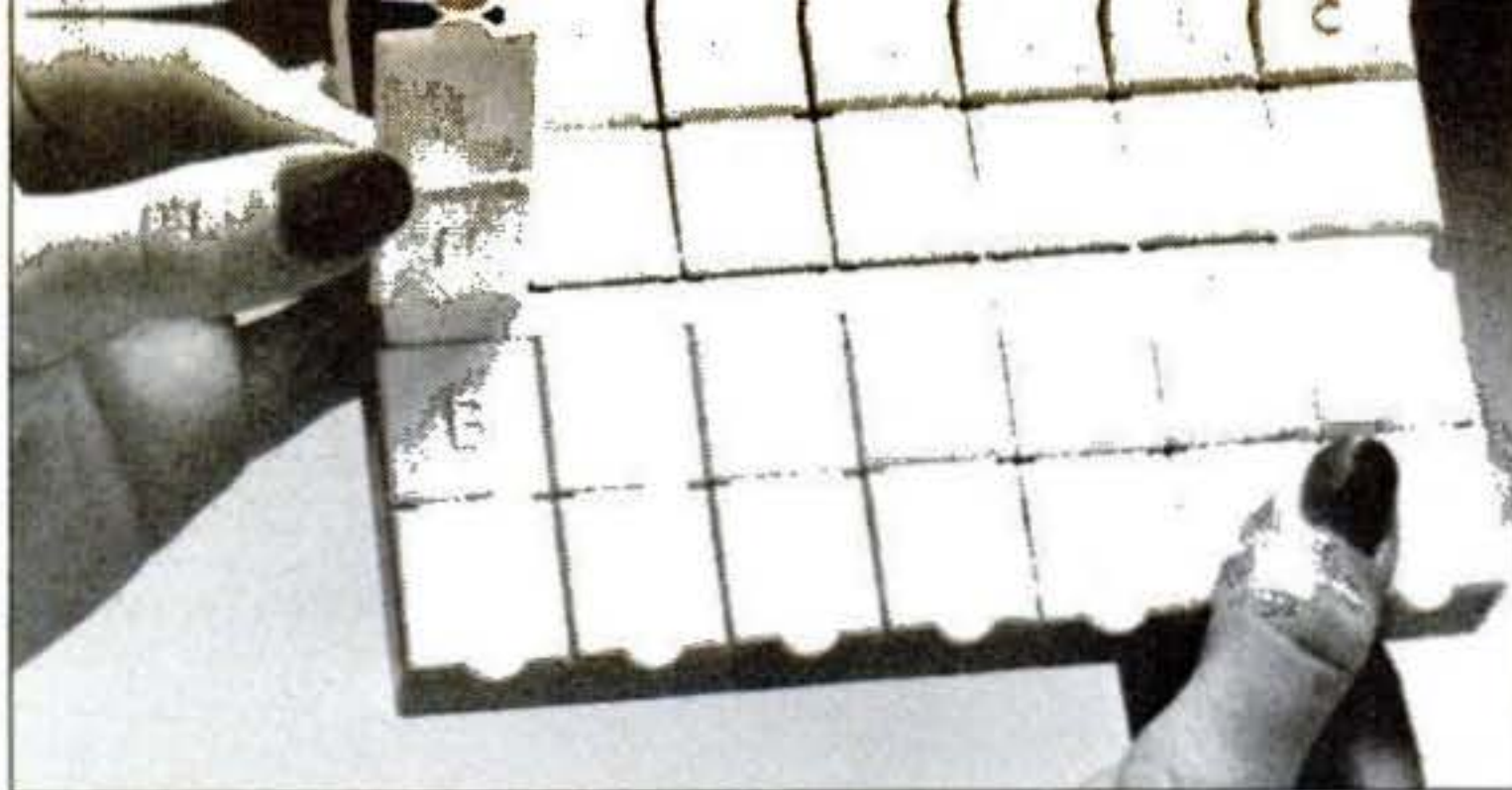
Microcomputer-based electronic controls in this giant Japanese dump truck boost efficiency and maneuverability while reducing user costs, says Komatsu Ltd. Developed for large-scale mining, the 1,600-hp machine weighs 207,230 lbs. and can haul 176 tons.

Oil boom

For fast deployment to contain oil spills, this twin-tube oil boom can be unreeled from ship or shore as it's being inflated. The boom lies flat on rough water without rolling and is stabilized by an 18-in. fabric "keel," says Avon, the British maker.



What's New



Pillbox

For forgetful pill-takers, the new Mediplanner organizes the daily dose in four separately opening compartments. Each is marked, both with raised letters and Braille, for the time of day pills should be taken. Apex, 9601 Girard Ave. S., Bloomington, Minn. 55431. \$3.49.



Glass-wall school

Eight-inch-square glass blocks create unique, energy-efficient walls for the art school in Houston's Museum of Fine Arts. To cut air-conditioning costs, the Pittsburgh Corning blocks have a solar-reflective coating that reduces solar-heat gain by about 75 percent.

Supersonic dart

After wind-tunnel tests technicians inspect a full-size model of the Army's anti-armor projectile. Launched from a 105-mm tank gun, the dart will hurtle through the air as fast as 3,800 mph. Made of solid, super-hard metal, the dart should penetrate enemy tanks on impact.



Open-air plane

The canard wing on this kit-built plane has no rudder. But split rudders are built into the uptilted winglets at wing tips. Powered by a 25-hp snowmobile engine, the ultra-light plane can be foot-launched, so no license is needed. Goldwing Ltd., Box 1123, Jackson, Calif. 95642.

Gold digger

Like a giant vacuum cleaner, this portable dredge sucks up eight cubic yards of gold-bearing gravel an hour. Automatic processing in the sluice box secures even the finest gold dust, says Treasure Emporium (6507 Lankershim Blvd., N. Hollywood, Calif. 91606).



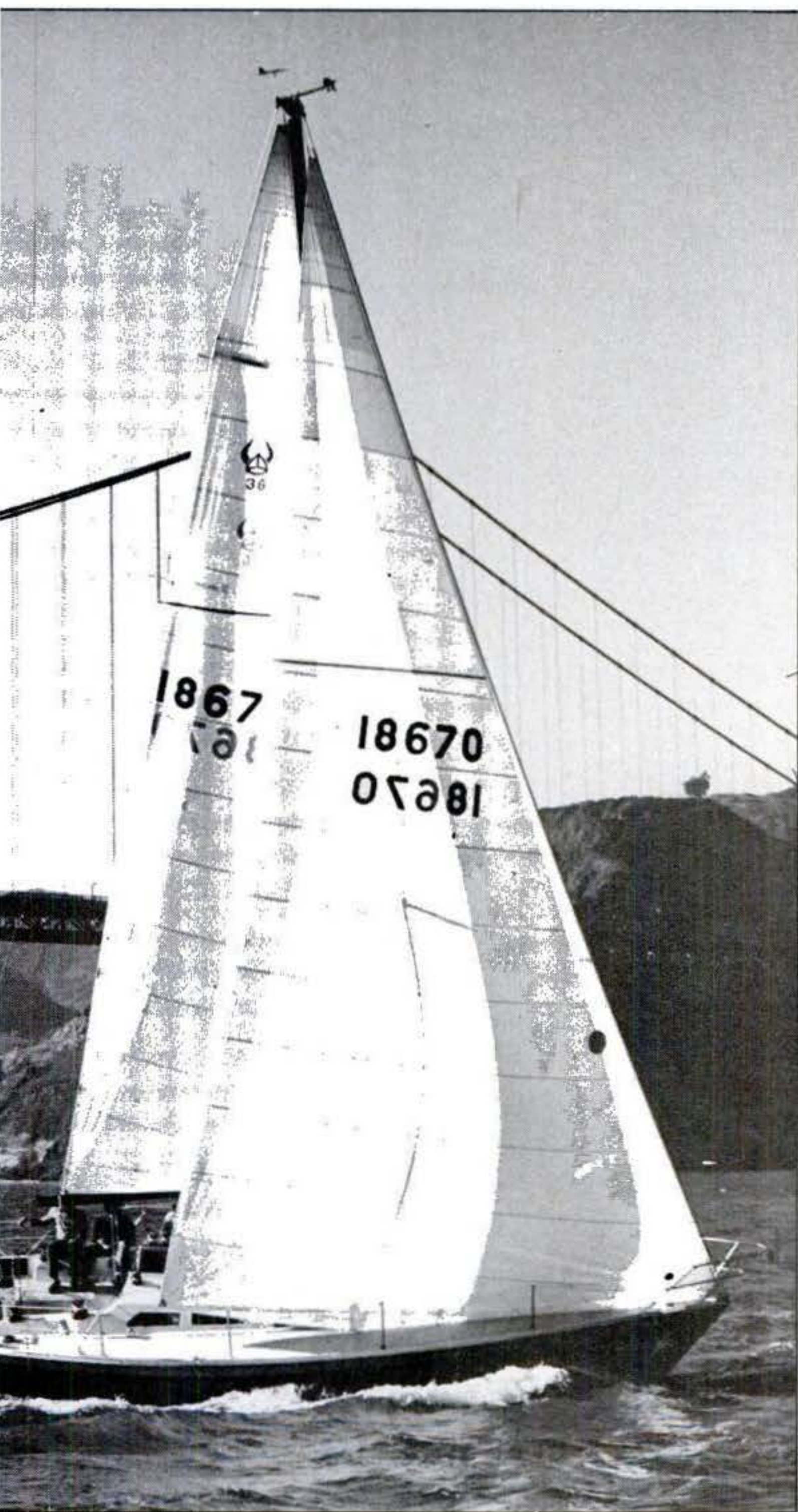
What's New IN BOATING

BY SUSAN RENNER-SMITH



Digital radio

Compact yet capable, the 4.4-lb. Homer 5 marine radio covers crystal-controlled frequencies from 50 kHz to 25 MHz. A programmable memory holds 18 stations, and a timer records four weather reports a day. It's \$2,200. Brookes & Gatehouse, 154 E. Boston Post Rd., Mamaroneck, N.Y.

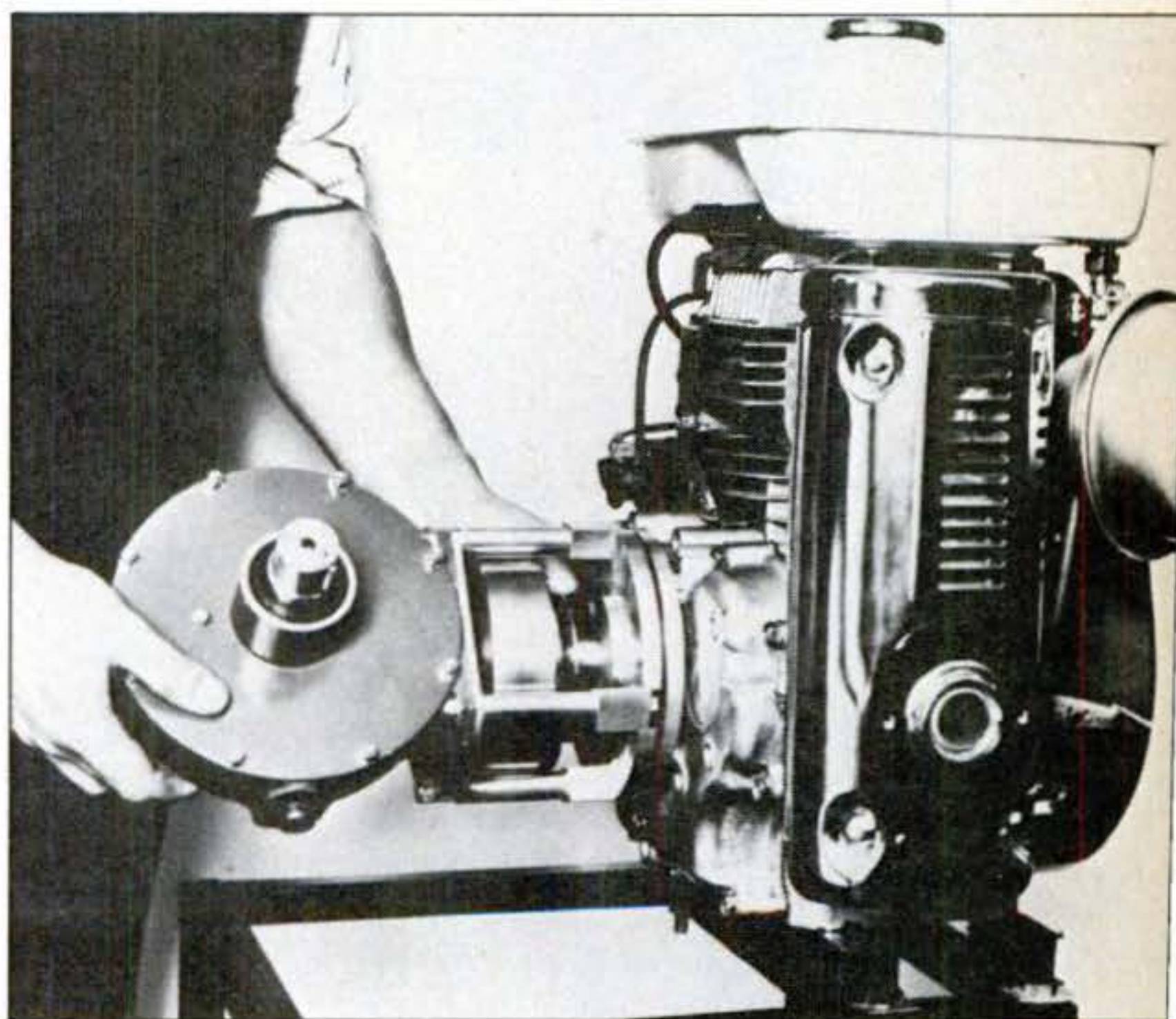


Racer-cruiser

Seaworthy as she is speedy, the race-winning E-36 doubles as a cruiser, says Ericson Yachts (1931 Deere Ave., Irvine, Calif. 92714). Its strong yet light hull has a unique structural grid of high-strength, unidirectional fiberglass.

Harness release

Sudden gusts of wind can turn a sailboarder's safety harness into a boom-tied trap. But a sharp tug releases the new stainless-steel Surf-safe, so the wind sailor can dive clear. Price is \$30 from Windsurfing Laguna, 29546 Sedgewick Circle, Laguna Niguel, Calif. 92677.



Compact launchers

Car-top boats glide easily to sea on these five-in.-dia. plastic rollers. Broad treads keep the craft moving smoothly. The V-shaped, axle-mounted cradle locks into a permanent fitting in the stern skag. ABT Products, Ross-on-Wye, Herefordshire HR9 5NF, England.



Shaft swiveler

With this flexible coupling, an inboard engine can be installed in the most accessible spot. An expanding centrifugal clutch on the engine's shaft engages the coupling; crown and pinion gears turn the drive shaft to the proper angle. Holywell Works, Chesterfield, Derbyshire, England.

What's New IN TOOLS

BY PAUL BOLON



Flexible finisher

Flexand's abrasive discs are 10 to 20 times deeper than sandpaper. That means the grit lasts much longer, according to Flexand Abrasives (48 Northlands Rd., Southampton SO1 2LG, England). The discs, available in three grits, are spaced widely to avoid clogging the flexible metal base.

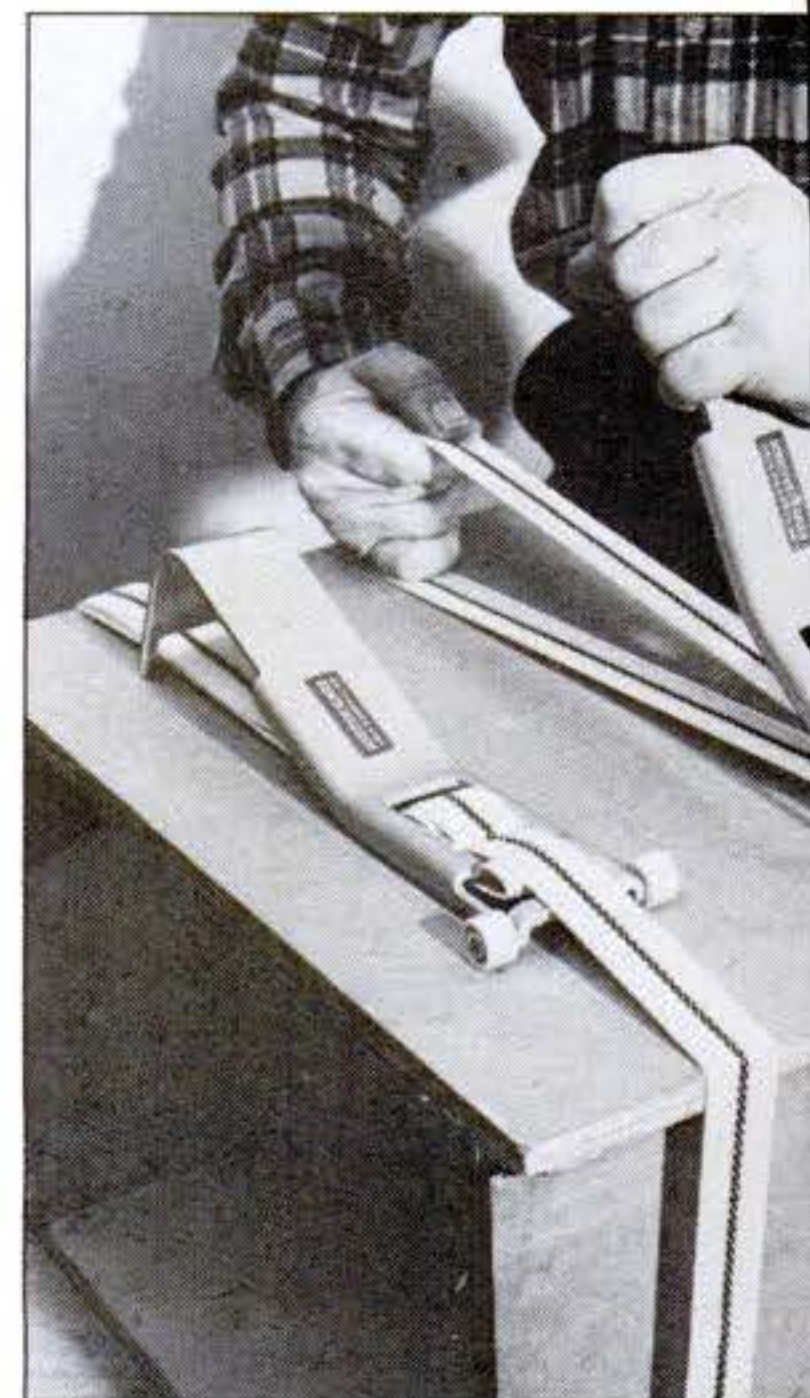


Backup generator

A 10-hp Briggs & Stratton industrial-grade engine powers this five-kW McCulloch generator—the largest the company's ever manufactured. Either 120- or 240-V current can be produced, with twin receptacles for each output. The unit weighs 141 lbs. Price: about \$1,500.

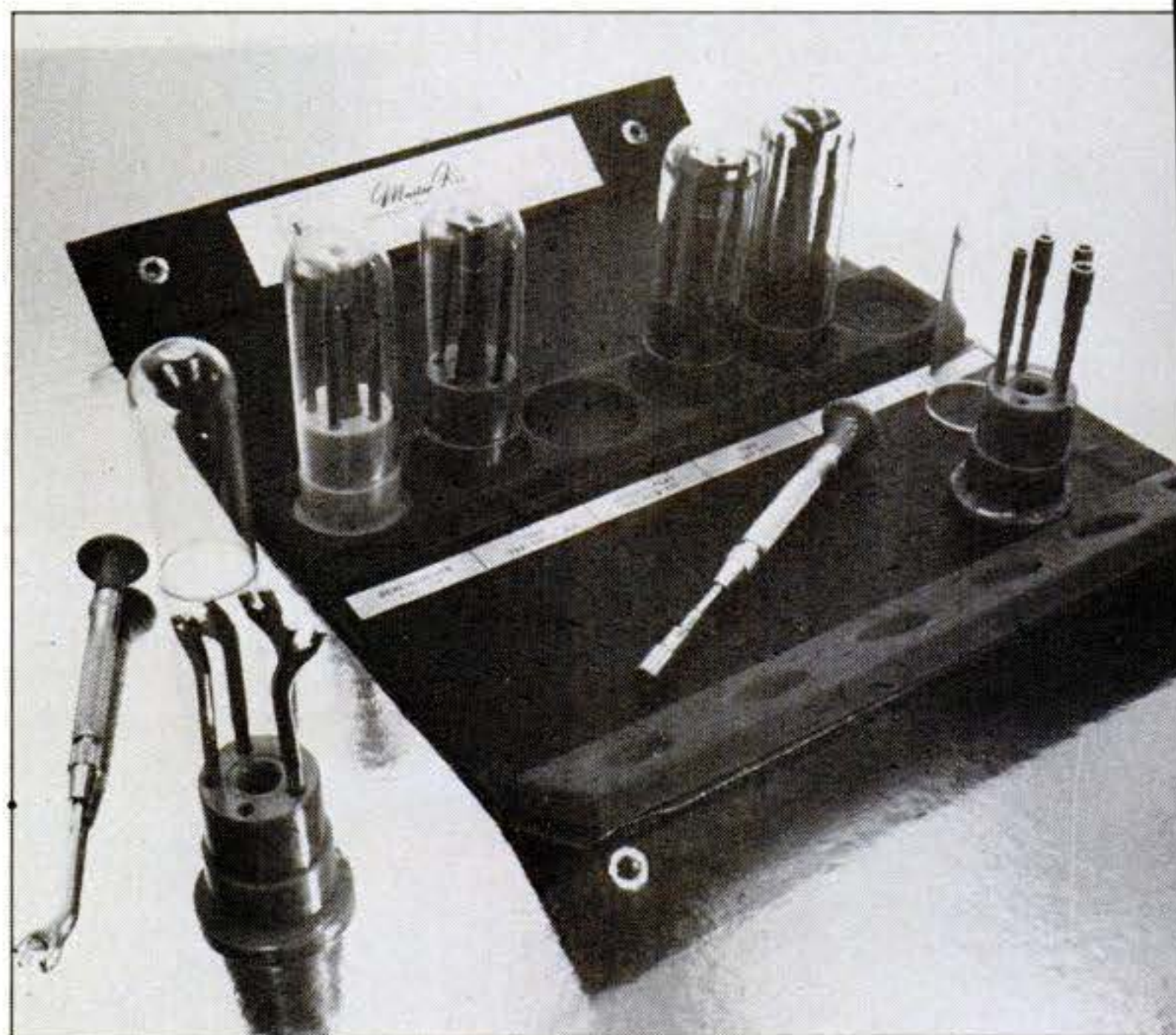
Big belts

Cinching up large projects for gluing is easy with the big handles and heavy, tear-resistant nylon belts of the Lammello Spanner. With 16-ft.-long belts, the clamps are \$53 a pair. Colonial Saw, 100 Pembroke St., Kingston, Mass. 02364.



Tiny-tool kit

Tools for elf-size jobs: The Master kit has six sets of small-face tools, including off-set wrenches, sockets, screwdrivers, Allen wrenches, and complementary tap drills and thread-tapping kits. Six sets and case cost \$60. Moody Tools, 42-60 Crompton Ave., E. Greenwich, R.I. 02818.



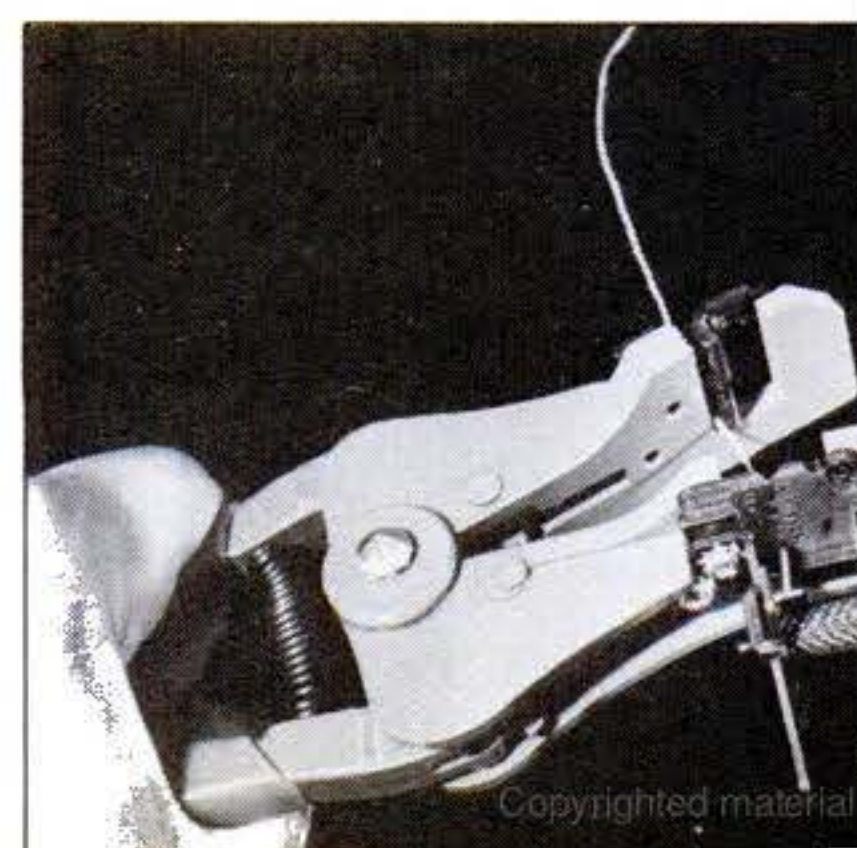
Abrasive block

Scrape rust and corrosion from exposed metal with Rust Remover, an abrasive nylon-fiber block containing industrial abrasives. The flexible block is washable and tear-resistant, says Norton Co. (Consumer Product Div., One New Bond St., Worcester, Mass. 01606). It's \$1.79.



Stripper

An adjustable wire stop on the ST-300 wire stripper lets you produce constant-length wire leads with just a squeeze of the hand. The tool strips 14- to 22-gauge wire in measured lengths to 3/4 in. Price: \$9.95. O.K. Machine and Tool, 3455 Conner St., Bronx, N.Y. 10475.



What's New

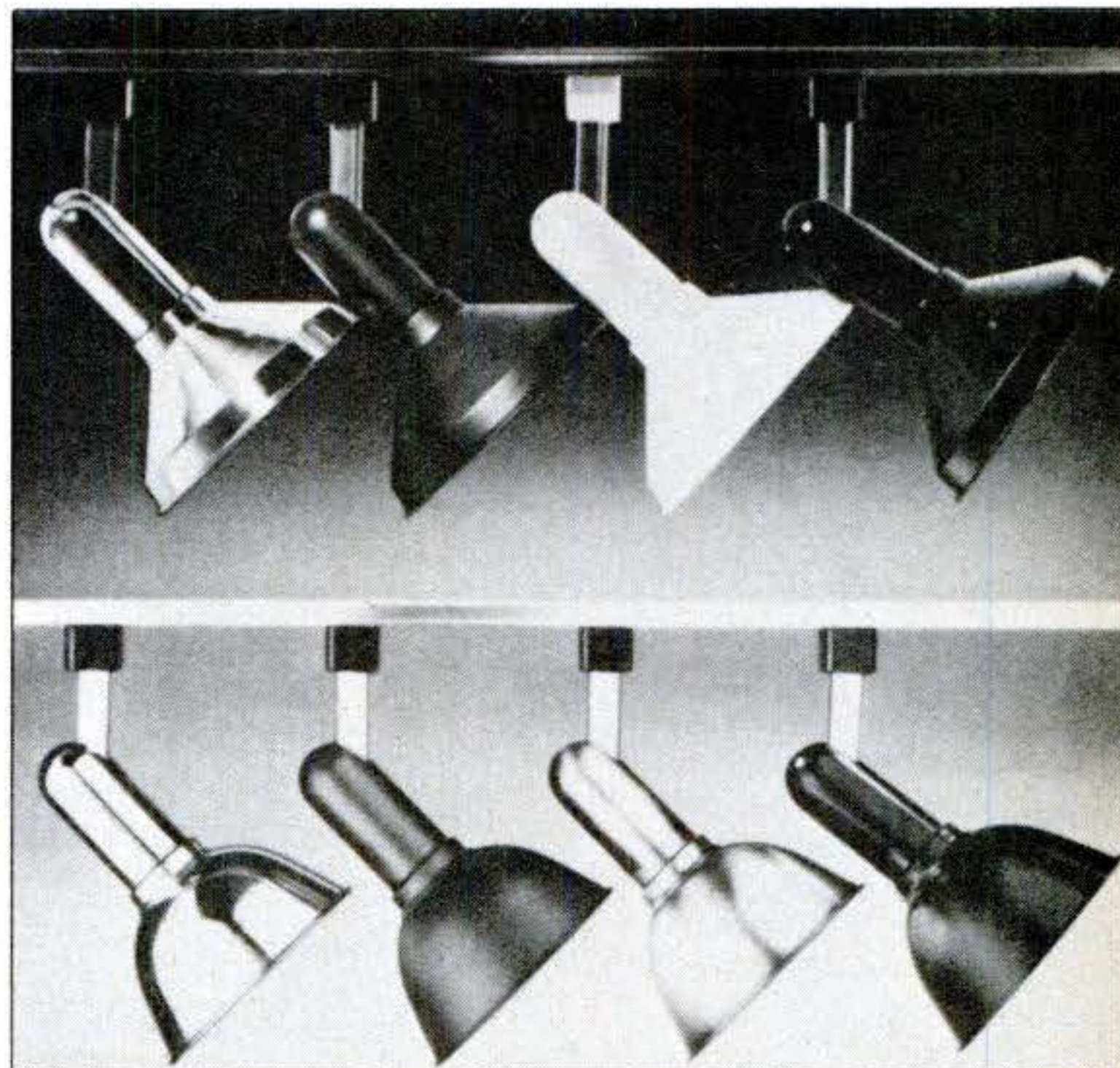
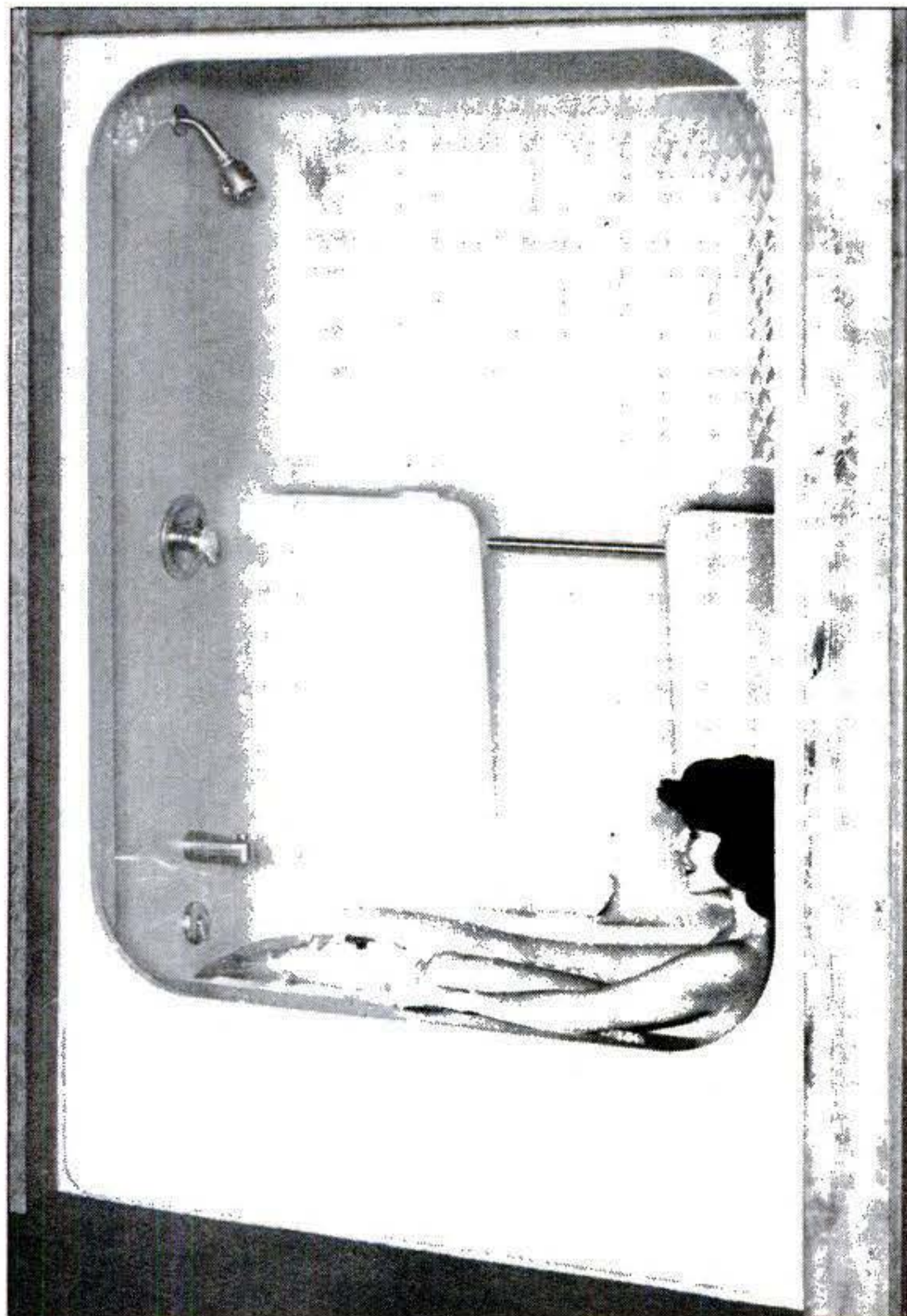
IN HOME IMPROVEMENT

BY PAUL BOLON



Watt savers

It's bright as a 60-watt incandescent bulb but uses only 22 watts of power—that's GE's Circlite 60. The fluorescent bulb and adapter unit fits standard incandescent sockets, costs \$11. The Circlite 50/100 uses 16 and 44 watts, respectively. It's \$22.



Whirlpool bath

No room for a whirlpool? Take one in your tub. Aqua Whirl's tub/shower has two adjustable jets and an air-volume control, says Aqua Glass Corp. (Box 412, Industrial Pk., Adamsville, Tenn. 38310). It sells for about \$1,000; additional jets are optional.

Two for the tracks

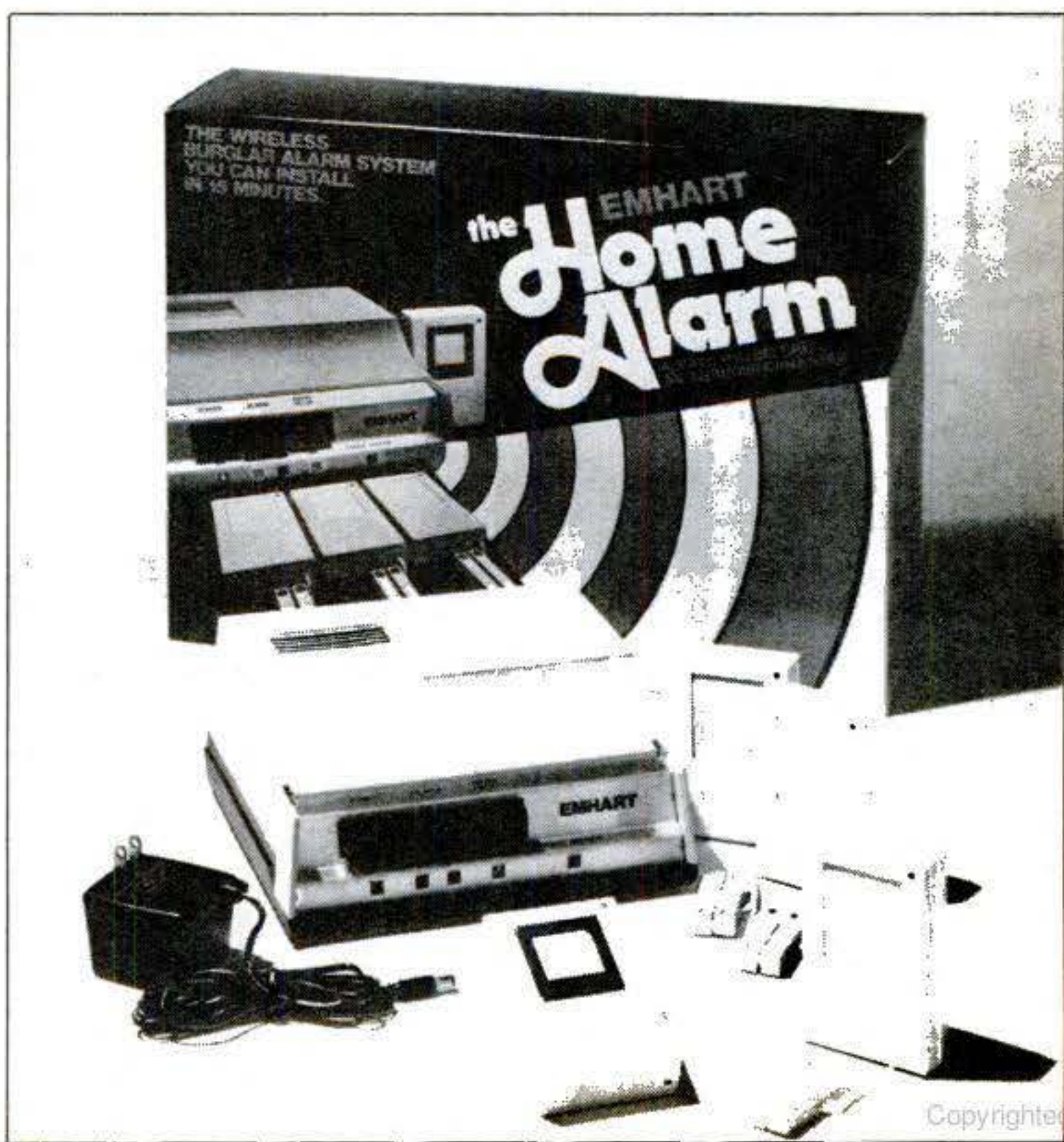
Cones and hemispheres are just two of the new reflector-shade shapes for McGraw-Edison's Power-Trac residential track-lighting system. Lamp holders come in brass, bronze, white, and matte-black finishes. Light Products Div., 400 Busse Rd., Elk Grove Village, Ill. 60007.

Portable alarm

Hook it onto your hotel-room door and the Door Alarm warns you of potential intruders by emitting staccato shrieks whenever it senses motion. Made by Emhart, the nine-volt, battery-powered alarm also has a sensitivity control. Notifier Co., 560 Alaska Ave., Torrance, Calif. 90503. Price: \$22.

Home alarm

When they're tripped, battery-powered transmitters at entry points will radio the console of Emhart's Home Alarm to sound a siren. The \$269 system has a remote disarm switch, outdoor siren, and car alarm transmitter as options. Also from Notifier Company.



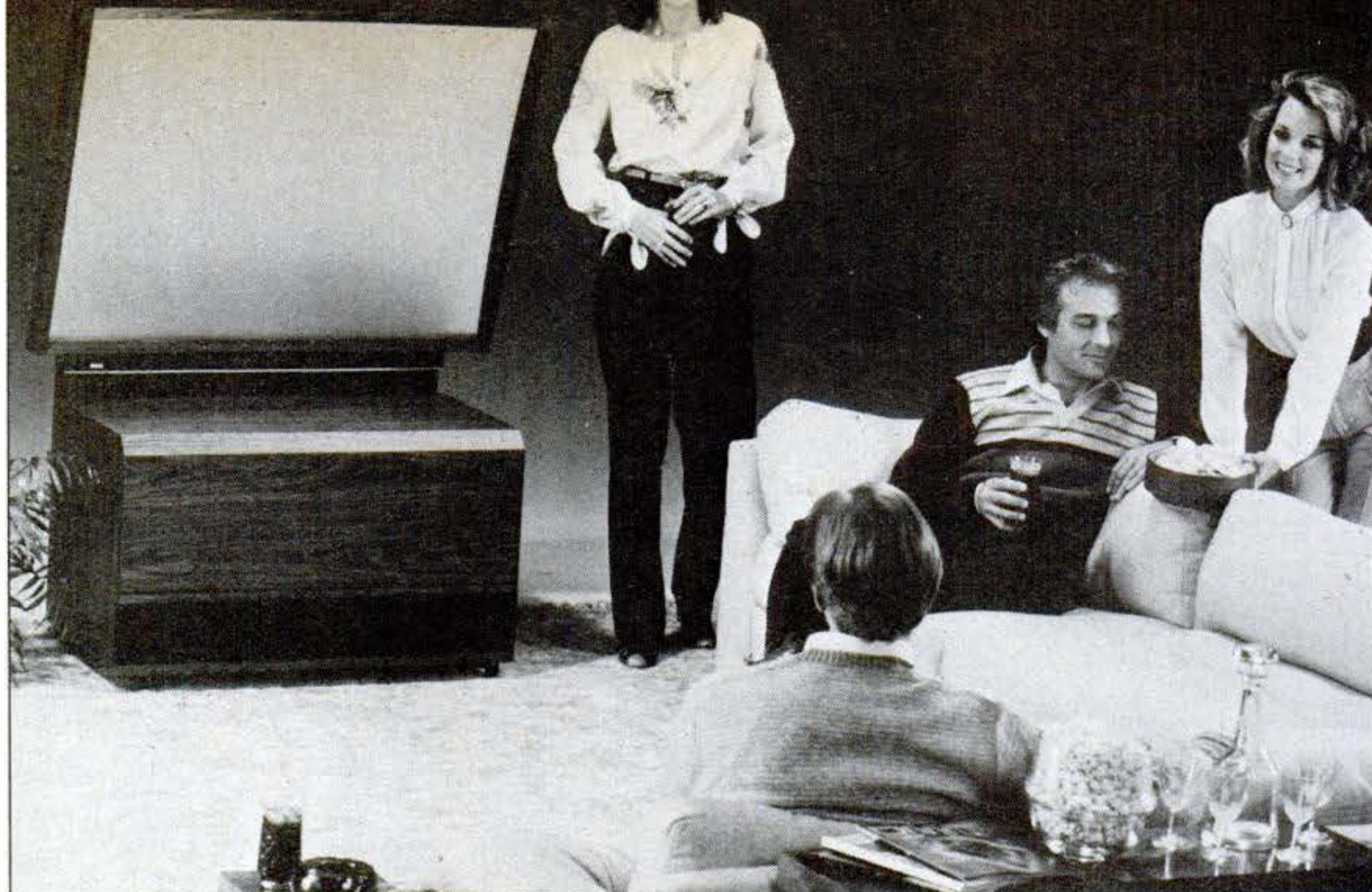
What's New IN ELECTRONICS

BY WILLIAM J. HAWKINS



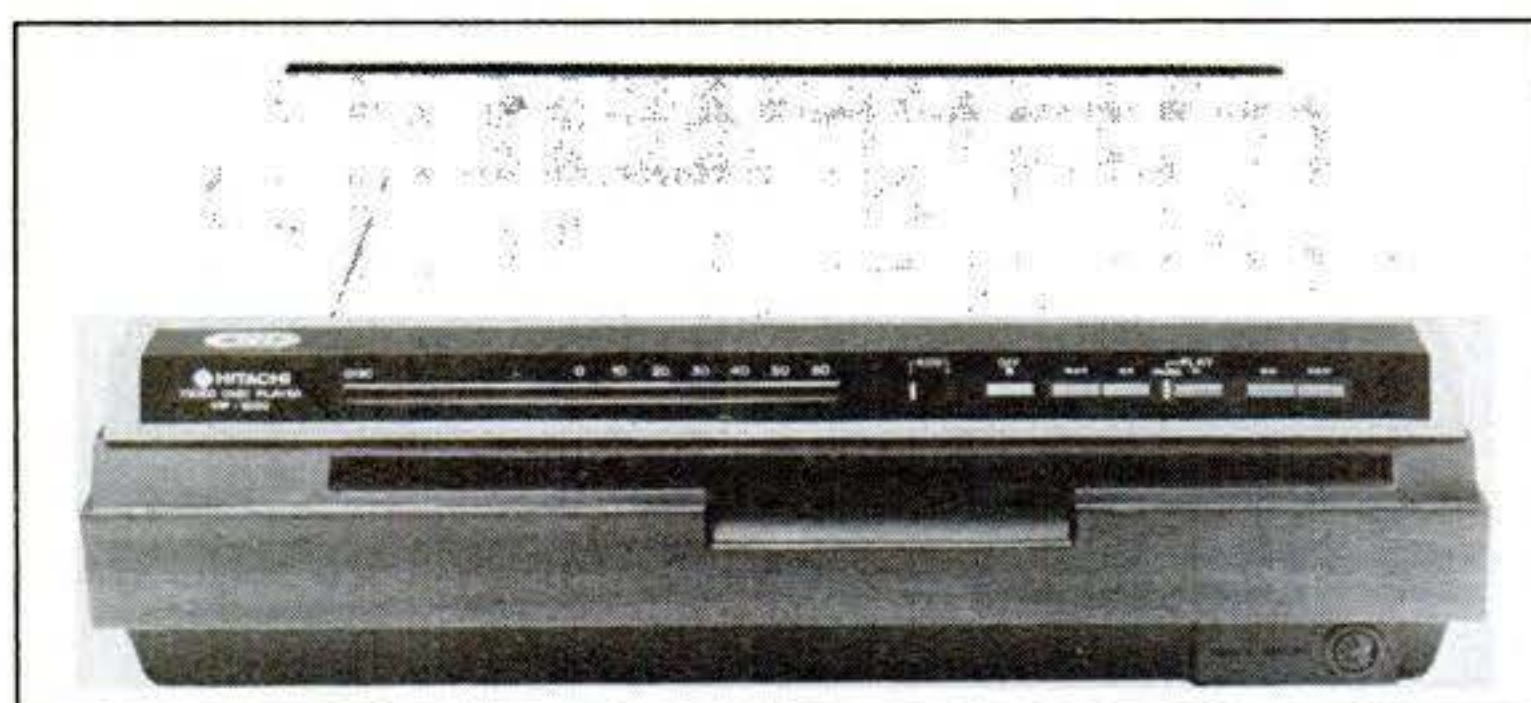
Plug n' talk

Just plug this extension phone into any AC wall outlet in your home—your voice is sent over the house wiring to a base console that connects you to the phone line. Made by Mura, 177 Cantiaque Rock Rd., Westbury, N.Y. 11590, the AC Mura-phone is \$130.



Projection TV

What's bigger than the 50-inch-diagonal screen on the front of this TV? The company behind it. RCA has now entered the projection-TV business. The front-projection unit has 10 watts per channel for stereo sound, and terminals for tape or disc systems. It's \$3,200.



CED videodisc

Insert a CED videodisc into this Hitachi VIP-1000 player and enjoy the show for the next two hours. Buttons control two fast-forward and reverse speeds, pause, and still framing. The \$500 player has connections for audio, video, or RF output and for optional remote control.



Quality compact

MGA has added one more thing to its all-in-one hi-fi system—high quality. It uses a vertical linear-tracking turntable, metal-tape deck with Dolby, AM/FM stereo tuner, microphone mixer, and electronic touch controls. Rated at 25 watts per channel, the X-10 System is \$690.

Electronic gin

Just deal—Card Challenger uses an optical scanner to check its hand and a microprocessor to, perhaps, beat you at gin, skat, cribbage, hearts, or piquet. Plug-in cartridges program it. Made by Fidelity (8800 N.W. 36th St., Miami, Fla. 33178), it's \$155.

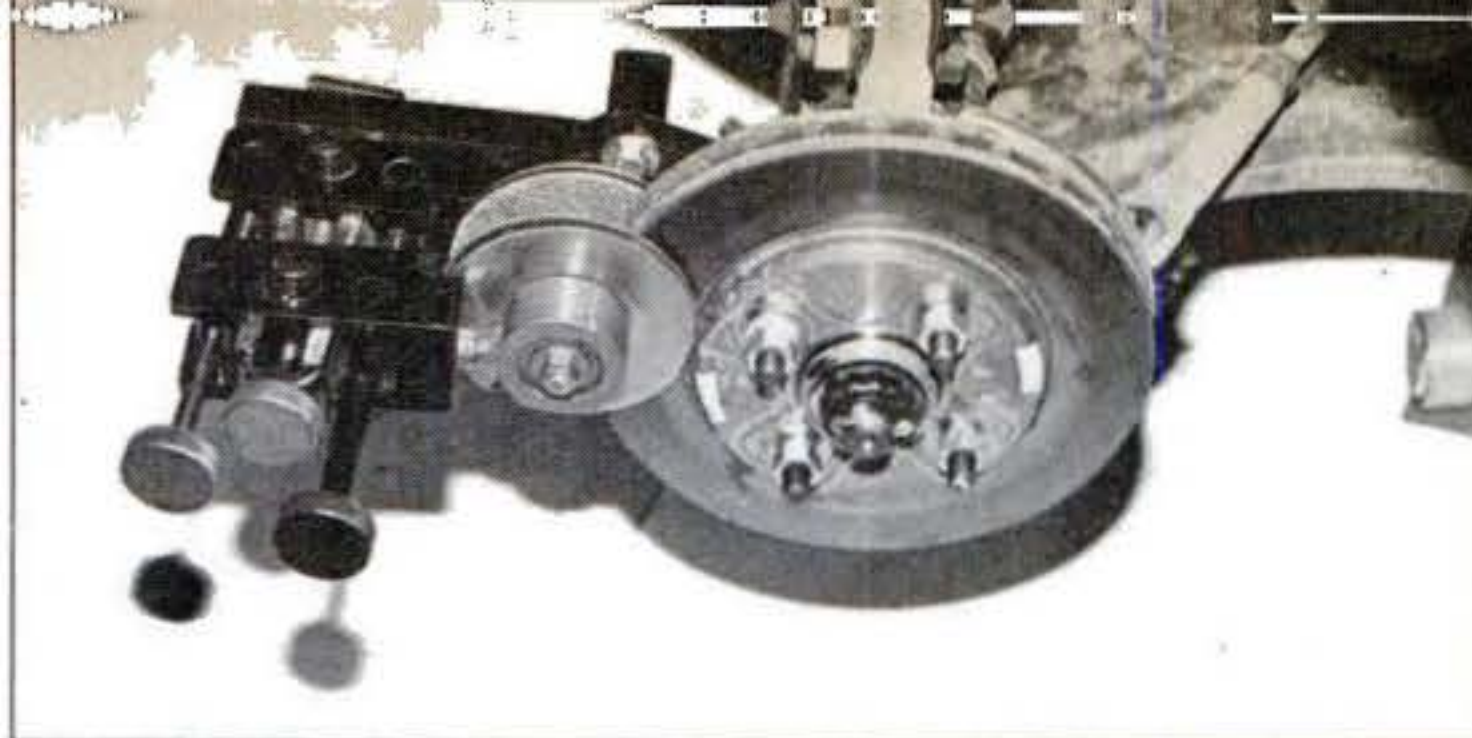
Sobriety tester

Push a button and breathe into this ALCO Check from CTC (6600 France Ave. S., Minneapolis, Minn. 55435). If you get a red light, you've flunked its electronic sobriety test—don't drive. A green light means you've passed. No light proves you couldn't find the button. It's \$129.50.



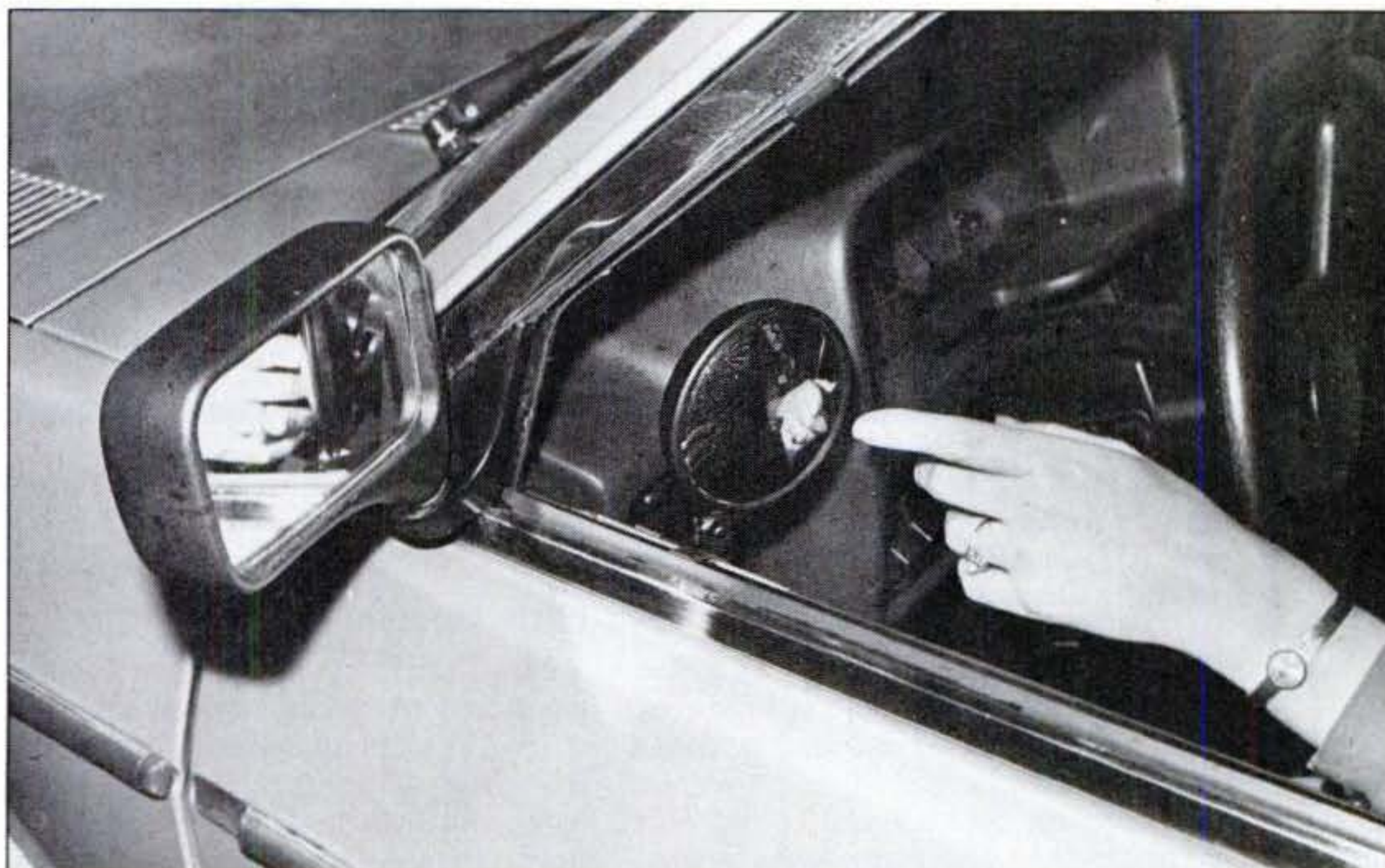
What's New FOR YOUR CAR

BY ED JACOBS



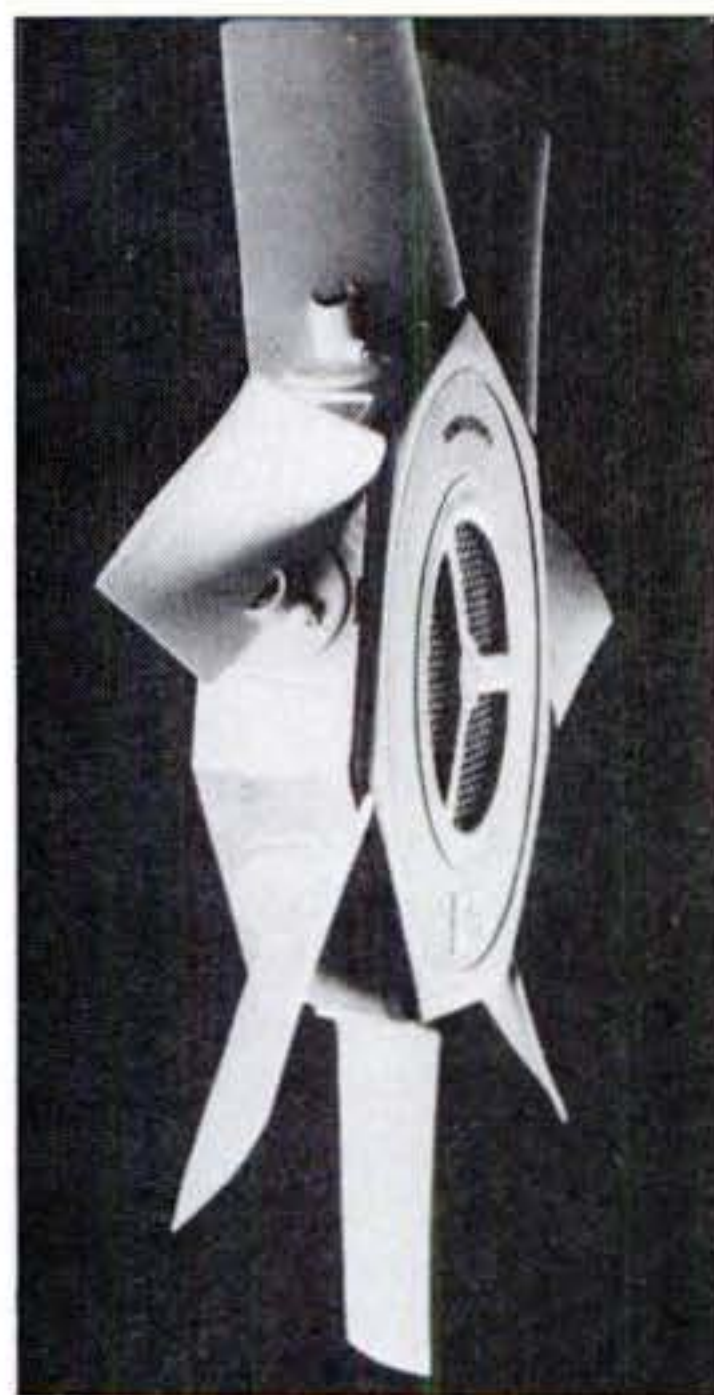
Disc-brake grinder

Once the brake caliper has been removed, this grinder simultaneously resurfaces both sides of the brake rotor—on the car—with a swirl finish. Gramlich Disc Brake Grinding Inc., 4 Melanie Dr., Unit 15, Mississauga, Ont., Canada L5S 1H2.



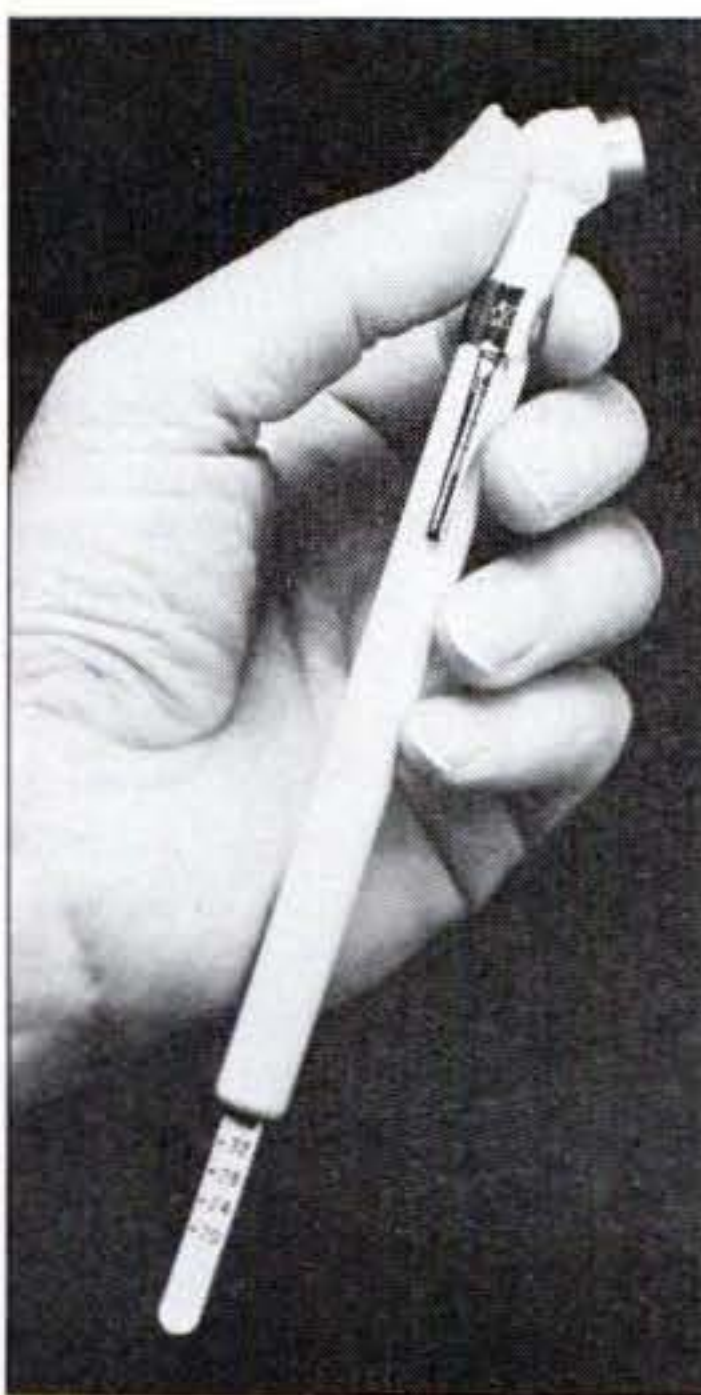
Wide-view mirror

An inside-the-car wide-angle mirror with an 85-degree field of view supplements the outside mirror to cover your vehicle's blind spot. It's made of shatterproof plastic. B. J. Snee, Box 21, 4797 ZG Willemstad, Holland.



Variable-pitch fan

The Quinton Hazell Thermo-fan's blades change pitch up to 30 degrees to meet varying cooling needs. A temperature sensor mounted in the hub controls blade swiveling. Quinton Hazell Ltd., Hazell House, Leamington Spa, Warwickshire CV32 6RF, England.

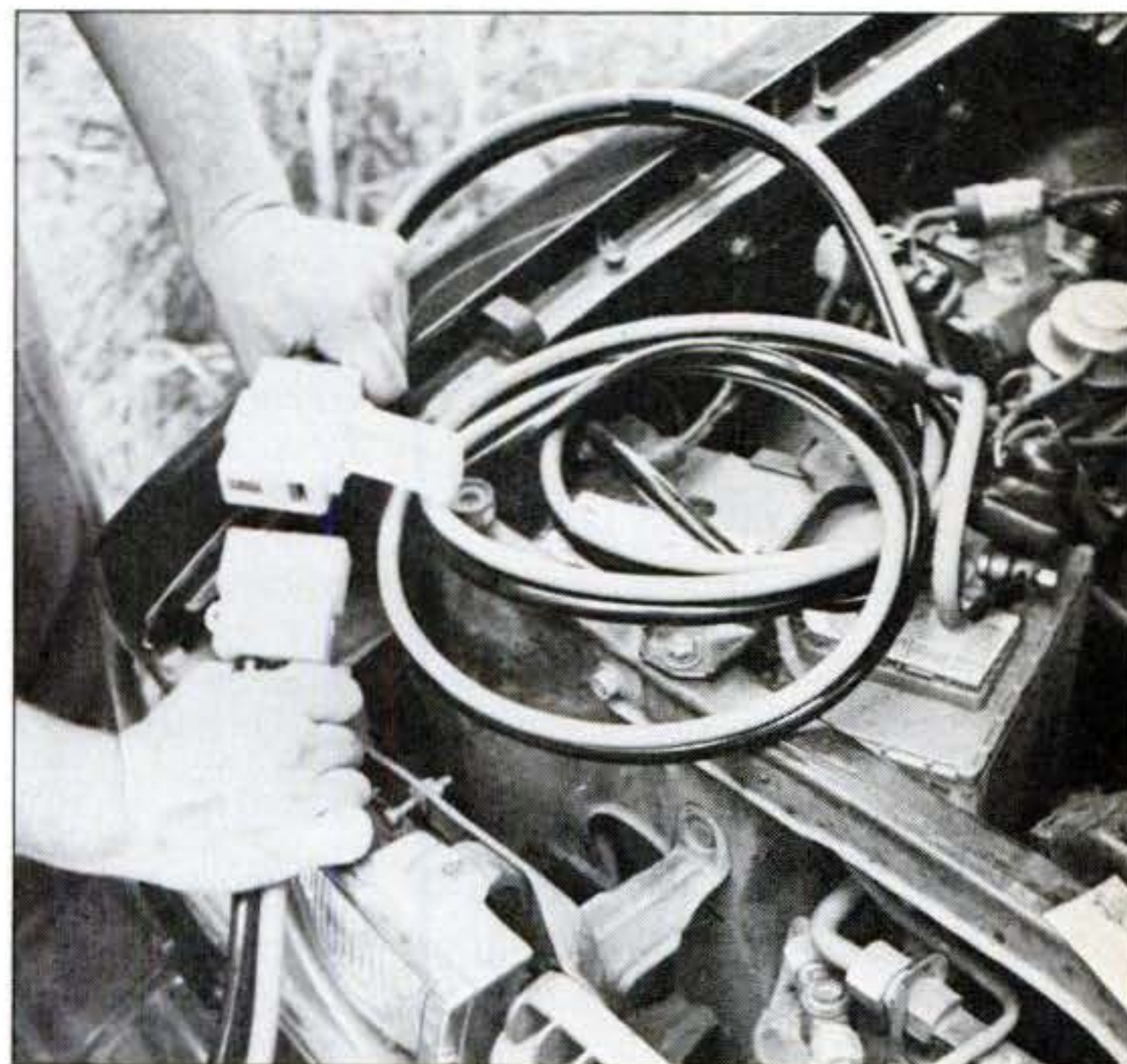


Tire gauge

Eaton's model 5600 tire gauge can measure pressures up to 80 psi and is compatible with all current passenger-car tires, including high-pressure temporary spares. It's molded of lightweight Delrin and costs about \$4 at auto-parts and department stores.

Magnetic light

With its built-in magnetic mount, this trouble/inspection light sticks to many convenient surfaces on your vehicle. It plugs into the cigarette lighter and has a 12-foot windup cable. Heart's Desire, Box 4763, San Diego, Calif. 92104. Cost: \$4.95, ppd.



Safe jumper cables

An LED indicates when you have the proper battery hookup with these cables, and a polarized central connector lets you join the cable sections away from potentially explosive battery fumes. Price: \$37. Colbrese Cable Corp., Box 1251, Homewood, Ill. 60430.

Detroit preview

— fuel-efficient designs for '82 and '83

**PS forecasts the cars
of autumn—and those
of the coming years**

By JIM DUNNE

The procession of new domestic models that have appeared at intervals over the past 18 months will continue. But that will not diminish the impact of Detroit's traditional fall introduction rituals. In a few months the auto makers will unveil their latest styling and engineering innovations, whetting public appetites with better fuel economy and more comfortable small sedans. Here's a preview of what's coming, along with a forecast of new models due in 1983 and later.

A new line of front-wheel-drive sedans will take a position between the compacts and intermediates at Chevrolet, Pontiac, Buick, and Oldsmobile. The cars are based on the X-body's 104.9-inch wheelbase and have most of the X-car's technical features, including four-cylinder and V6 engines and fuel-economy ratings in the 22/38-mpg city/highway range. Major differences will be styling and luxury features. The new A-body line—GM's designation, but not to be confused with the rear-wheel-drive A-bodies sold under the Malibu, Le Mans, Century, and Cutlass names—consists of two-door and four-door notchback sedans. The four-doors will have six-window side styling, with a vent window behind the rear door in place of a metal sail panel. Chevrolet Celebrity and Pontiac A6000 (see photo) are new names in this line.

The one major change at Cadillac will be a blockbuster—an all-aluminum V8 with 250-cu.-in. displacement.

This will be Cadillac's standard engine, replacing the innovative V8-6-4 [PS, Oct. '80]. Reports indicate that the aluminum block will be built with the proved sand-casting technique, and will feature iron inserts for the cylinder walls instead of a die-cast block with bare aluminum cylinder walls. Electronic fuel injection will be standard on this advanced and efficient engine. The controversial styling of Cadillac's Seville rear end will be altered slightly: A boxier trunk will ease the extreme profile.

Another major change is focused on Camaro and Firebird. They are smaller and lighter and are restyled substantially. But for all the changes, the sporty models are easily recognizable as GM's muscle cars. Most-interesting changes include a 2.5-liter (153 cu. in.) four-cylinder engine as standard, MacPherson-strut suspension in front, and a weight reduction of 650 pounds. Accounting for that last change are a shortening of the wheelbase by almost six inches and of overall length by about a foot. Camaro and Firebird sales have nose-dived in the past 14 months, and GM hopes that the changes, which are primarily aimed at improving fuel economy, will restore their popularity.

Another strong entry in GM's 1982 lineup will be a compact pickup. Code-named the S-truck, it will have true half-ton capacity and use four-cylinder gasoline and diesel engines, as well as V6's. This model is built like the big trucks, with separate frame-and-body construction. It's sized between the LUV import and the C-10 conventional pickup.

Oldsmobile will have a 3.2-liter (195 cu. in.) V6 diesel ready for 1982. It's a completely new design—not one converted from existing gasoline en-

gines—and will show up in Cutlasses and Olds' front-wheel-drive mid-size and compact sedans.

Little Lincoln

Lincoln will again try its luck in the compact-luxury-car market, this time with a Fairmont-based Continental four-door sedan that has a Lincoln front end attached to a Seville-style rear. Suspension-dampening inserts and noise insulation, along with expensive trim inside and out, will set this car apart from the Fairmonts, Zephyrs, Granadas, and Cougars that share its chassis and most drive-line parts.

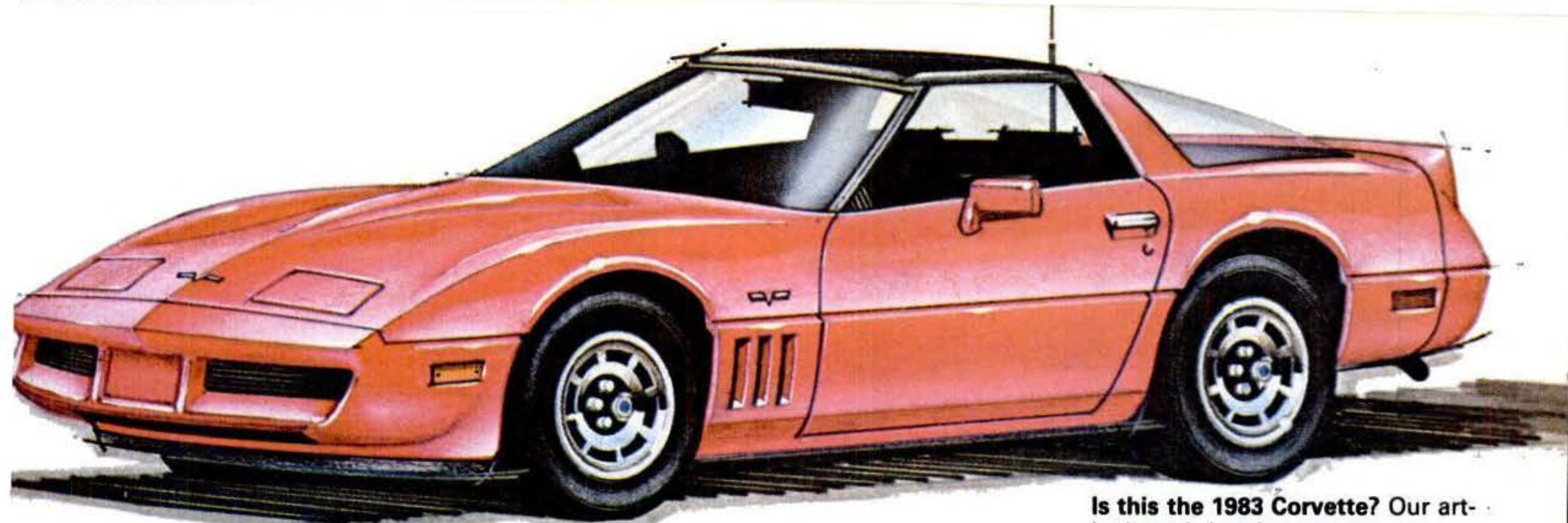
Escort/Lynx will have a four-door sedan to go with the hot-selling wagons and two-door models. The styling is conventional and features a bustle trunk and an extra window behind the rear-door glass. The addition of the four-door rounds out the Escort/Lynx line and allows Ford to switch its attention to front-wheel-drive models for its compact- through full-size lines in the next three years.

One new engine is planned, a 240-cu.-in. iron-block V6 that is based on the 302-cu.-in. V8 design. It will power the full-size Ford LTD and Mercury Marquis, but could show up in the new Lincoln, as well.

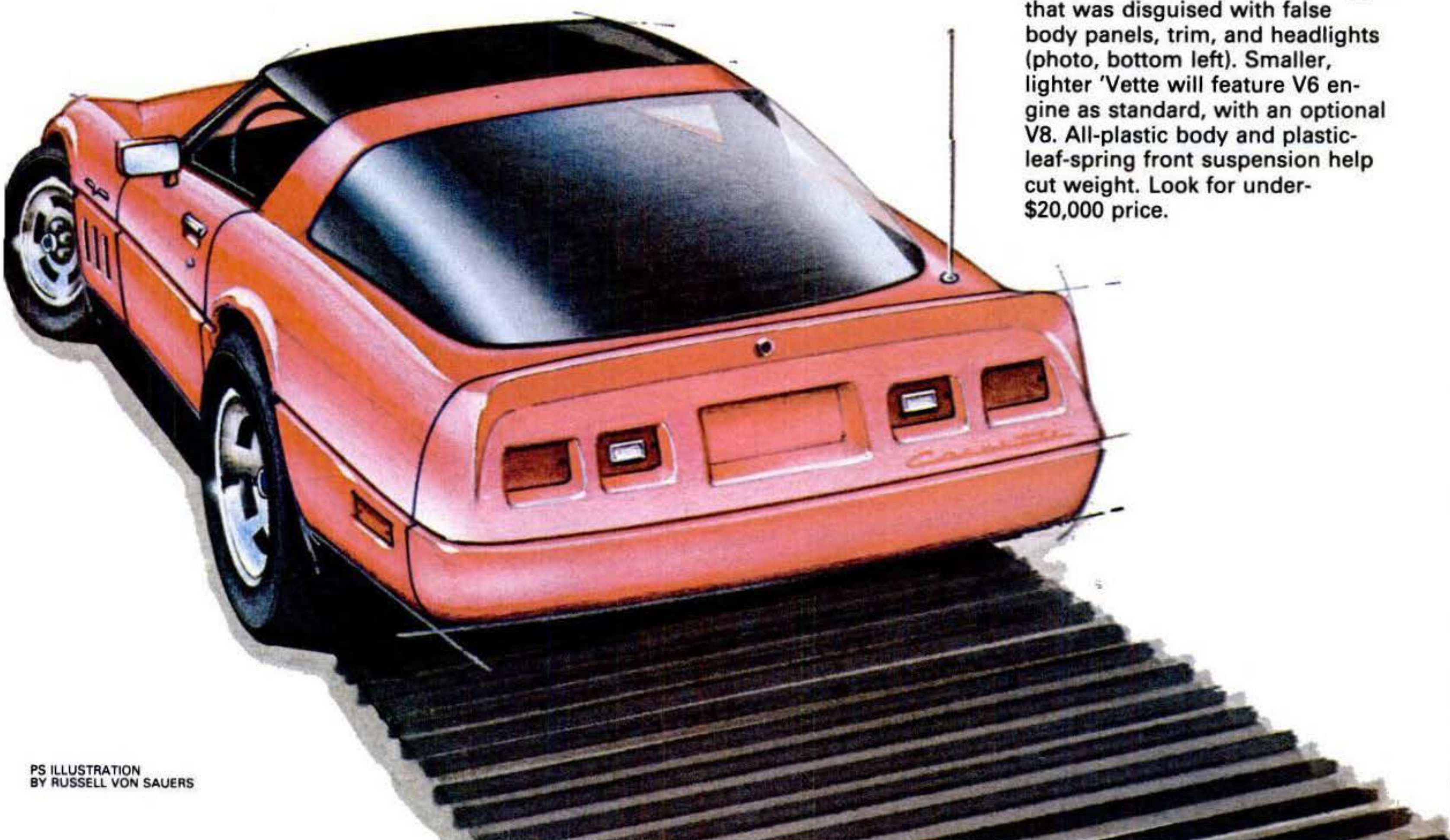
Ford's compact pickup is set for 1982½ introduction. Like the Chevy compact, it will have a four-cylinder engine and half-ton capacity, and be sized between the F-100 and Courier. The chassis will ride on a separate frame, a design similar to that of the full-size Ford pickups.

New-product ambitions at Chrysler have suffered several setbacks and will continue to slide if sales do not improve. The Super-K models that

Continued



Is this the 1983 Corvette? Our artist based drawings on a prototype that was disguised with false body panels, trim, and headlights (photo, bottom left). Smaller, lighter 'Vette will feature V6 engine as standard, with an optional V8. All-plastic body and plastic-leaf-spring front suspension help cut weight. Look for under-\$20,000 price.



PS ILLUSTRATION
BY RUSSELL VON SAUERS



Pontiac's eagerly anticipated P-car will arrive next spring as an '83 model. Developed as a two-passenger vehicle for commuting, the mid-engine rear-drive model has a 2.5-liter four-cylinder power plant mounted just ahead of the rear axle. The plastic-bodied car should offer high performance and excellent fuel economy. Expected price range: \$10,000 to \$12,000.



were planned for 1982 have been set back at least six months. That means a pickup truck, high-style coupe, and convertible will be the only newly designed models from Chrysler in the coming months. The coupe and convertible carry a Chrysler nameplate and look like an Imperial version of the Mustang, but underneath they're all Reliant. The chassis uses the same front drive, engine, and transmission; and the suspension is an upgraded version of the Plymouth's. Though much smaller and lighter, the Chrysler coupe will compete against Thunderbird and Monte Carlo and sell in the \$10,000 price range.

At an even later date, according to Chrysler's latest report to the government loan board, the bigger front-drive sedans will be produced. Expect these cars as early as 1983, according to present plans.

Chrysler's pickup is to be built on the Horizon chassis, a design similar to that adopted by Volkswagen for its pickup. The cab will use Horizon's front sheet metal. With Horizon's four-cylinder engine and drive train, fuel economy will be exceptional for a domestically built pickup—probably in the 25/36-mpg range for city/highway driving.

For AMC 1982 shapes up as a mark-time year while the company gets in position to build its all-new Jeep- and Renault-based sedan line in 1983. Look for the current car and truck lines to be continued with few changes in 1982, but by this time next year all products will be ready for replacement. Among the important changes planned are a lightweight Jeep and a high-economy-sedan series that is smaller than the R-18 but bigger than the R-5 Le Car. Smaller engines, including a four-cylinder type adapted from the 258-cu.-in. in-line six AMC now builds, are in the works.

What about the more exotic models you've heard about? Look for the mid-engine, two-seat Pontiac P-car next spring, while the all-new Corvette will be out a year from this fall. Electrics are still at least three years away from mass production. By then, four- and five-cylinder diesels will be commonplace. **ES**

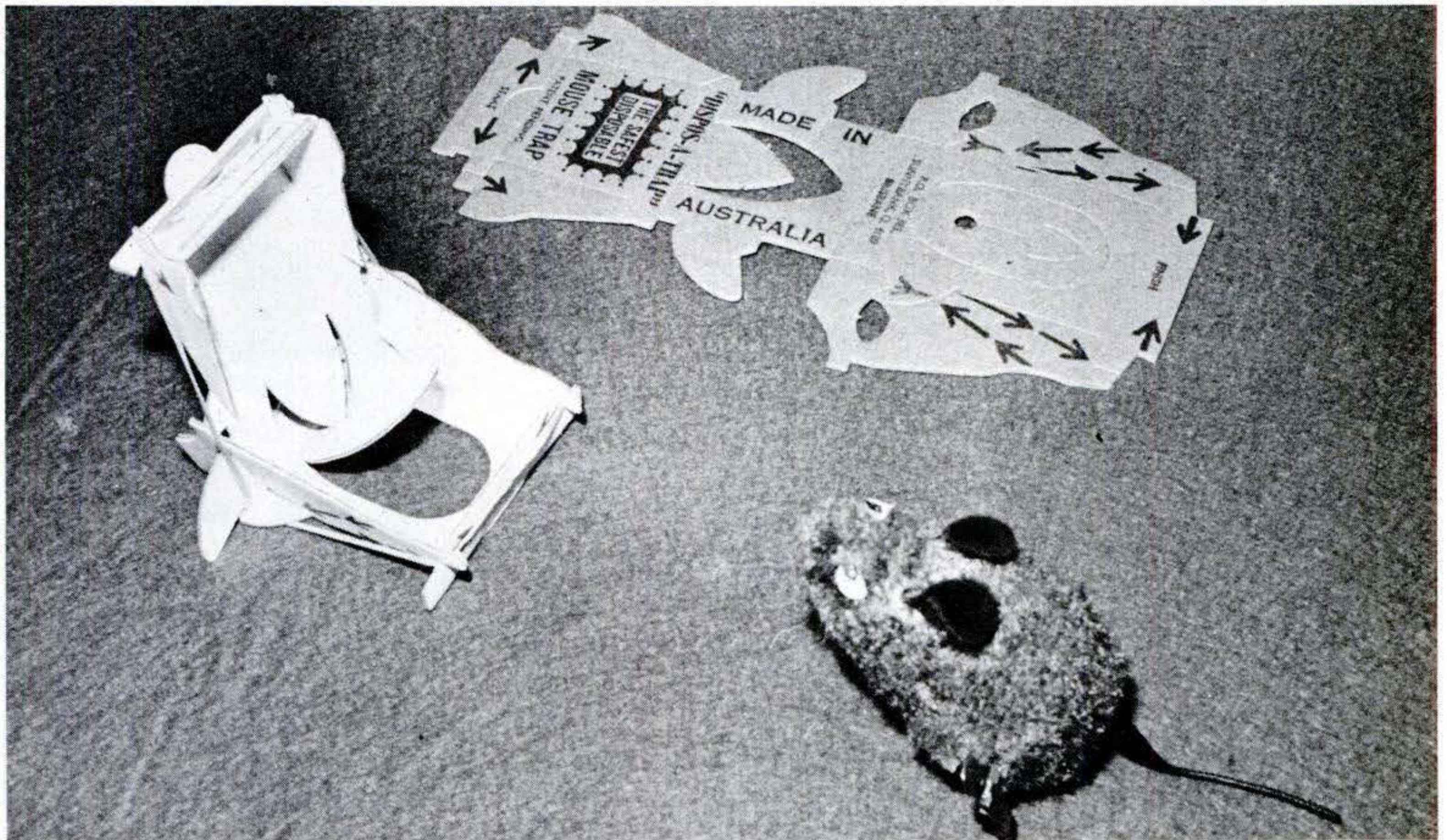


K-car convertible (top) will carry a Chrysler nameplate but be built from a Reliant coupe. Only 4,000 will be made. Price: \$12,000. Pontiac's A6000 will be offered in two- and four-door sedan body styles. Chevy S-truck will offer 50 percent better mpg than the current C-10. Seville-size Lincoln (bottom) borrows the former's bustle trunk, will sell in the \$13,000–\$15,000 range.

A better mousetrap

— and other clever contraptions from the Geneva International Exhibition

By DAVID SCOTT



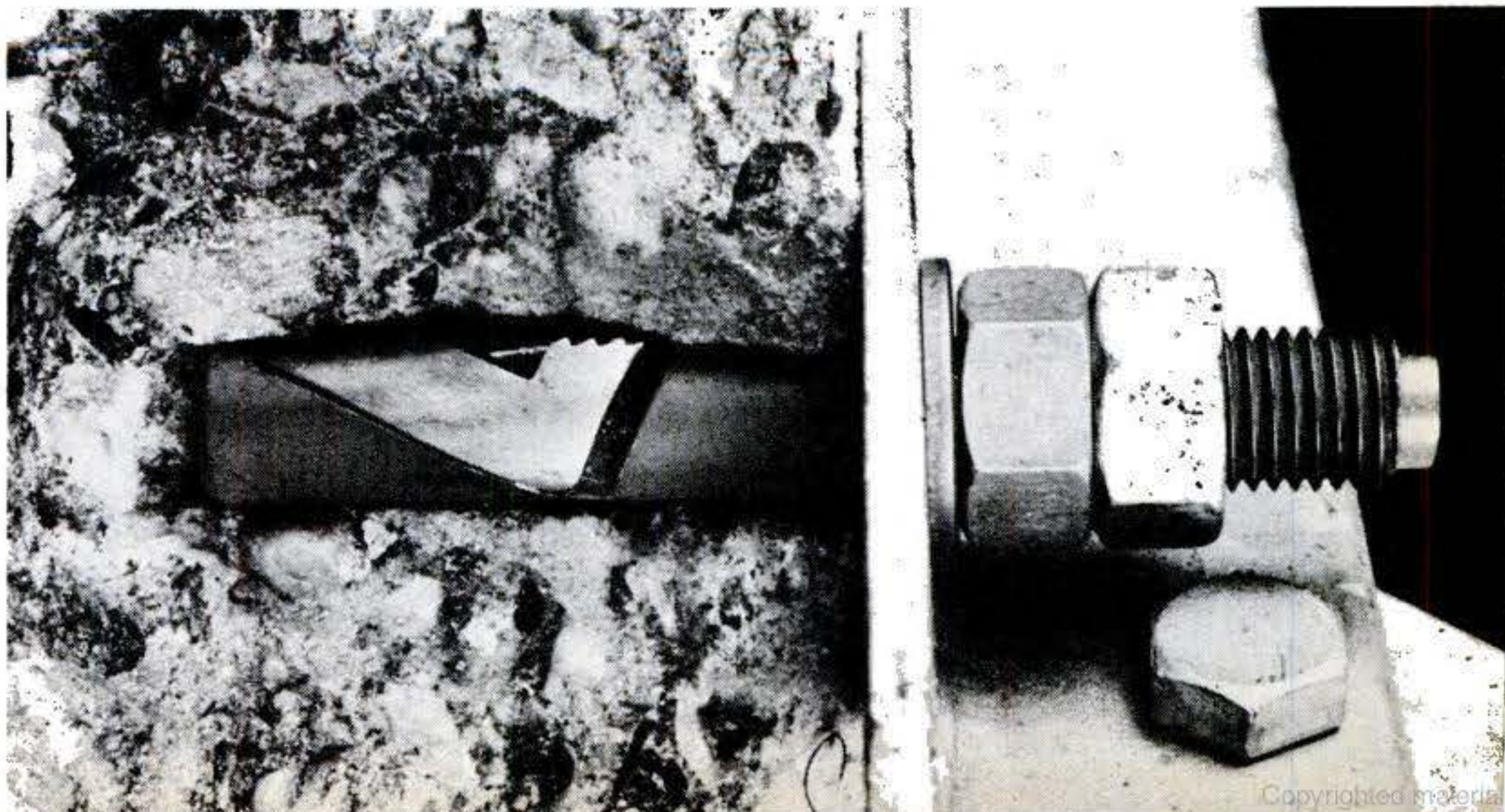
FOLDING MOUSETRAP

Why is this punch-and-press mousetrap better? Because it's disposable. The trap, a single piece of scored heavy cardboard, has printed arrows showing fold sequence. A rubber band serves as a spring and also holds the trap together. A V-slot on the trigger flap holds bait until the mouse springs the trap. Then you throw the whole thing away.

SELF-LOCKING BOLT

Instead of a sleeve, a curved, L-shaped slide with toothed ends anchors this bolt. Tightening forces the slide down on a spiral ramp until teeth bite into the wall and shank wedges against the hole.

For more from the inventors, turn page

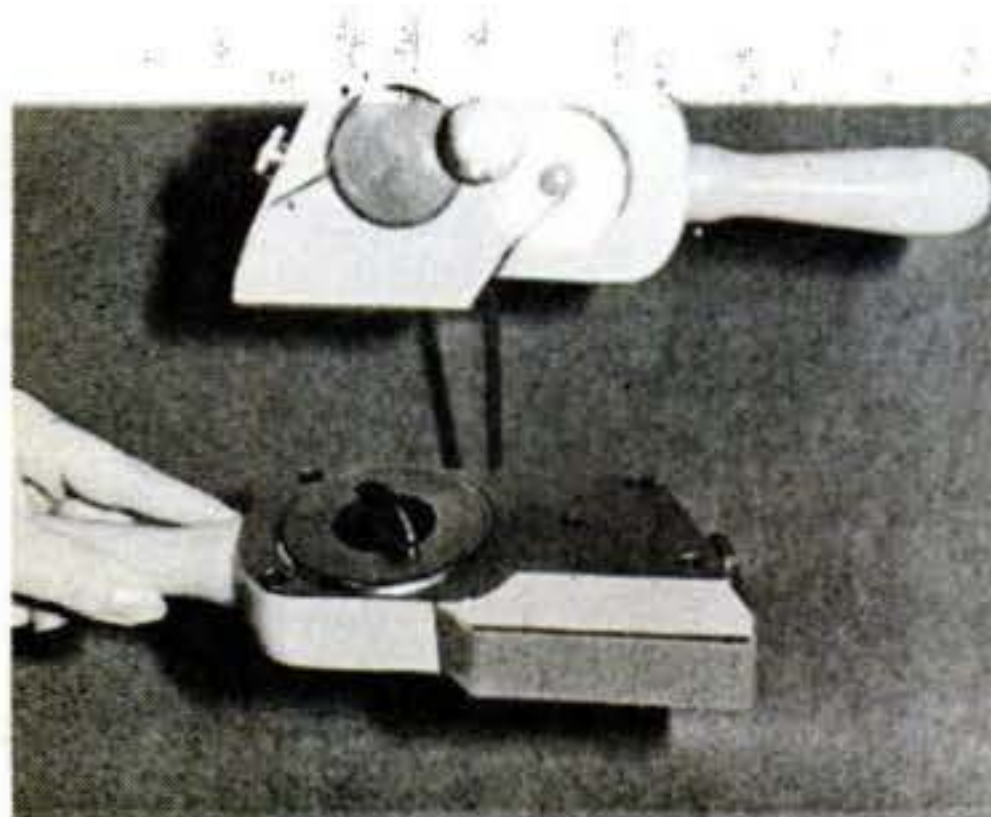




GENTLE GRIPPER

The fluorescent-tube holder has a 19-foot reach, so no ladders are needed to change lights. Spring clips at gripper's ends gently grasp the tube, positioning

it between a set of endless belts. Turning a knob on the handle rotates an inner shaft geared to the belt pulleys. The belts swivel the tube until contact pins snap into the light fixture.



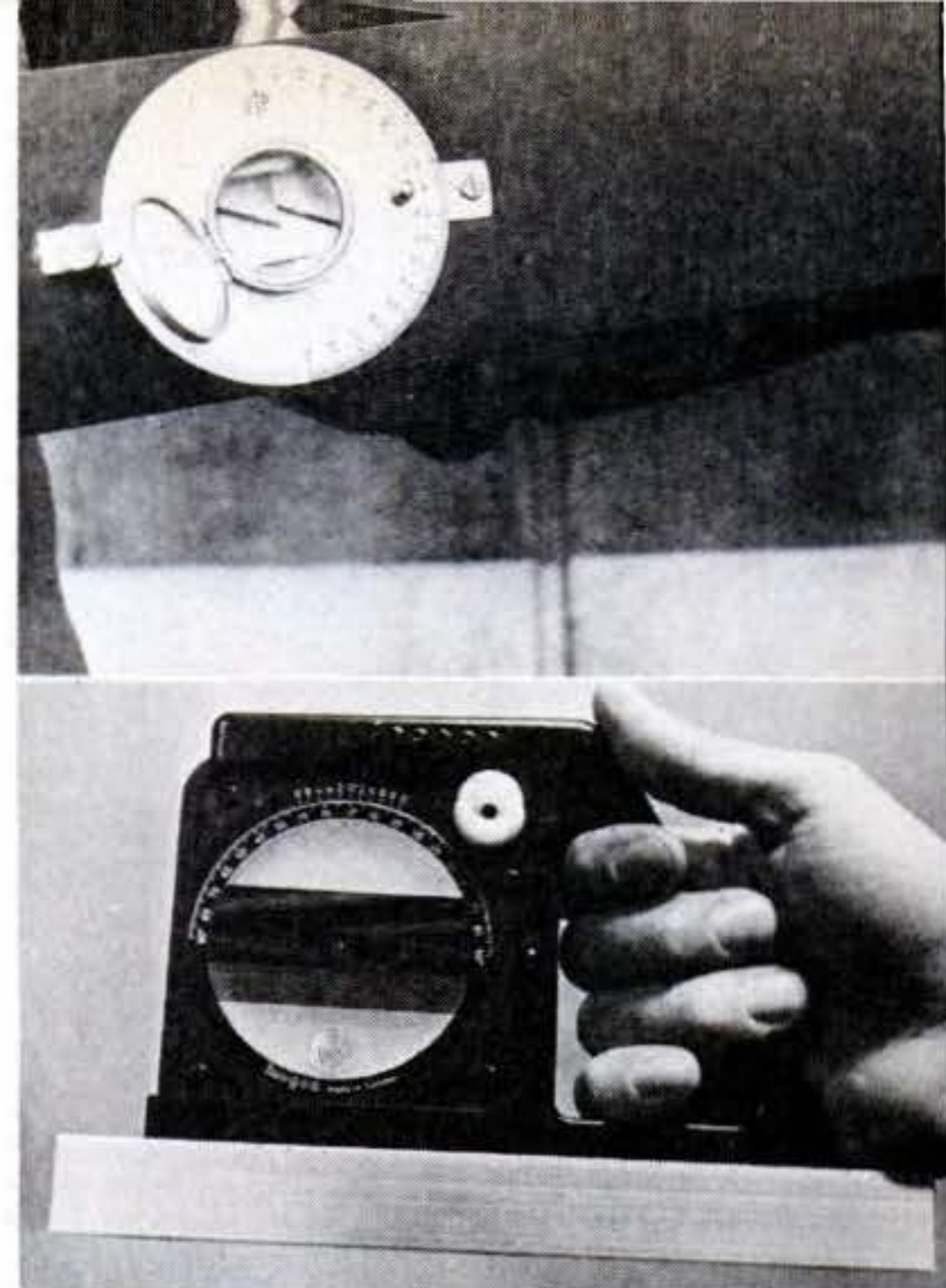
EVER-SHARP SANDER

Designed for fine work and lathe turning, this tool's double-cut nose smooths down hard-to-sand corners and grooves. Circular recesses on its underside hold a reel of abrasive strip and a takeup spindle (top view). A ratchet on the spindle's windup knob holds the strip taut, and a clamp keeps it in place. Releasing the clamp and turning the knob gives a fresh cutting edge.



CHEMICAL DEHUMIDIFIER

To curb dampness in enclosed spaces, this motorless machine uses calcium chloride salts. A perforated plastic dome contains a three-month supply of the salts. As they absorb moisture from the air, a weak, nonevaporating salt solution forms and drips into the bowl. When the slowly dissolving salts are depleted, a new, prefilled dome is snapped into place.



TINY TYPEWRITER

It weighs only two pounds yet stores the equivalent of 10 typewritten pages in its memory. The electronic typewriter has a conventional keyboard but is limited to 32 characters per line. Each line appears on an LED display for checking and correction before storage. The battery-powered unit has a line-voltage adapter (shown) for use at home base.

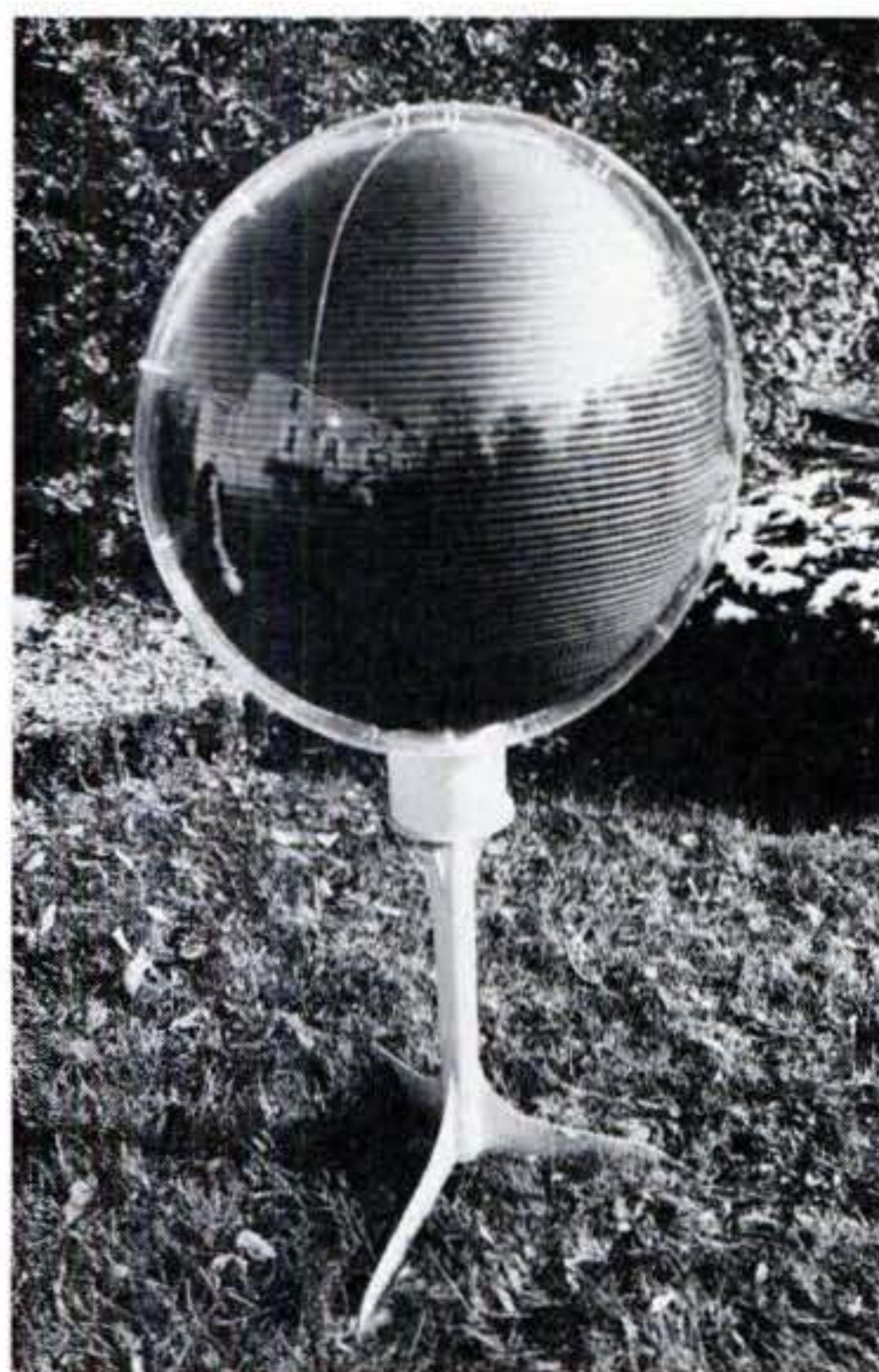
SHRINKING BIKE

Without folding, this collapsible bike shrinks to one-third its length. Releasing a clamp on the saddle upright lets front-wheel assembly roll back to pedals. Handgrips on the forked handlebars double as brake levers; no projecting levers complicate stowing the 25-lb. bike.



LARGE-FORMAT LEVELS

Two spiritless levels have unique, easy-to-read displays. The long one (upper left) doubles as a surveying instrument. Its hollow case has an eyepiece and an internal lens system with 30X magnification. The level's split-image display is formed by a crossbar mounted at the pivot point of an internal pendulum. The bar is viewed through a vertically mounted prism so any tilt distorts the display, creating the jagged lines shown. Only when the level is perfectly flat does a solid line appear. The zigzag lines on the tool at lower left also straighten out when level. The interference pattern is caused by light bouncing between two sets of fine horizontal lines. One is scribed on a disc that caps the water-filled circular housing. The other lines are etched on a disc that rotates freely on a pendulum-weighted ball bearing inside the level.



SOLAR WATER TANK

No matter what their angle, the sun's rays always illuminate the same amount of surface area on this solar sphere. The collector works anywhere, but it's designed for desert areas where chilled drinking water is scarce. Under the plastic cover, coils of dark-plastic hose encircle the five-ft.-dia. sphere. Inside are two hemispheres—80-gallon, insulated water tanks. By day, water pumped through the hose is solar-heated to 55 deg. C and stored in the hot-water tank. At night, when cool air chills the circulating water, flow is diverted to the cold-water tank. System is electronically controlled.

ROLL-UP ROCKER

Uncurled, it looks like a giant, blunt needle. But thread the tip through the eye (near right) and the fabric-covered foam becomes a cushy chair (far right). The tip becomes the back and rocking base, and the loop serves as armrests. Varying the roll-up tension adjusts height.



CARRY-ON SCOOTER

Portable as a suitcase when folded, this mini-motorscooter has a single handlebar tube that's pushed down flat to latch behind the back wheel. A central handgrip makes the 30-inch-long, 29-pound scooter easy to lift. The runabout is for stand-up riding. Its 23-cc, two-stroke engine can propel a 175-pound man at 20 mph.

DOUBLE-DUTY SOLAR TILE

With its built-in collection system, this roof tile doubles as a solar water heater.

Rows of blow-molded water tubes zigzag down the underside of each heat-absorbing, black-plastic tile. The end of each tube plugs into a matching socket on tile below. A set of pipes link the tubing runs to an indoor thermal storage tank.



Wood paneling

goes up with a clip

Clip-up installation gives this premium paneling a margin of safety against misplaced hammer blows

By V. ELAINE SMAY

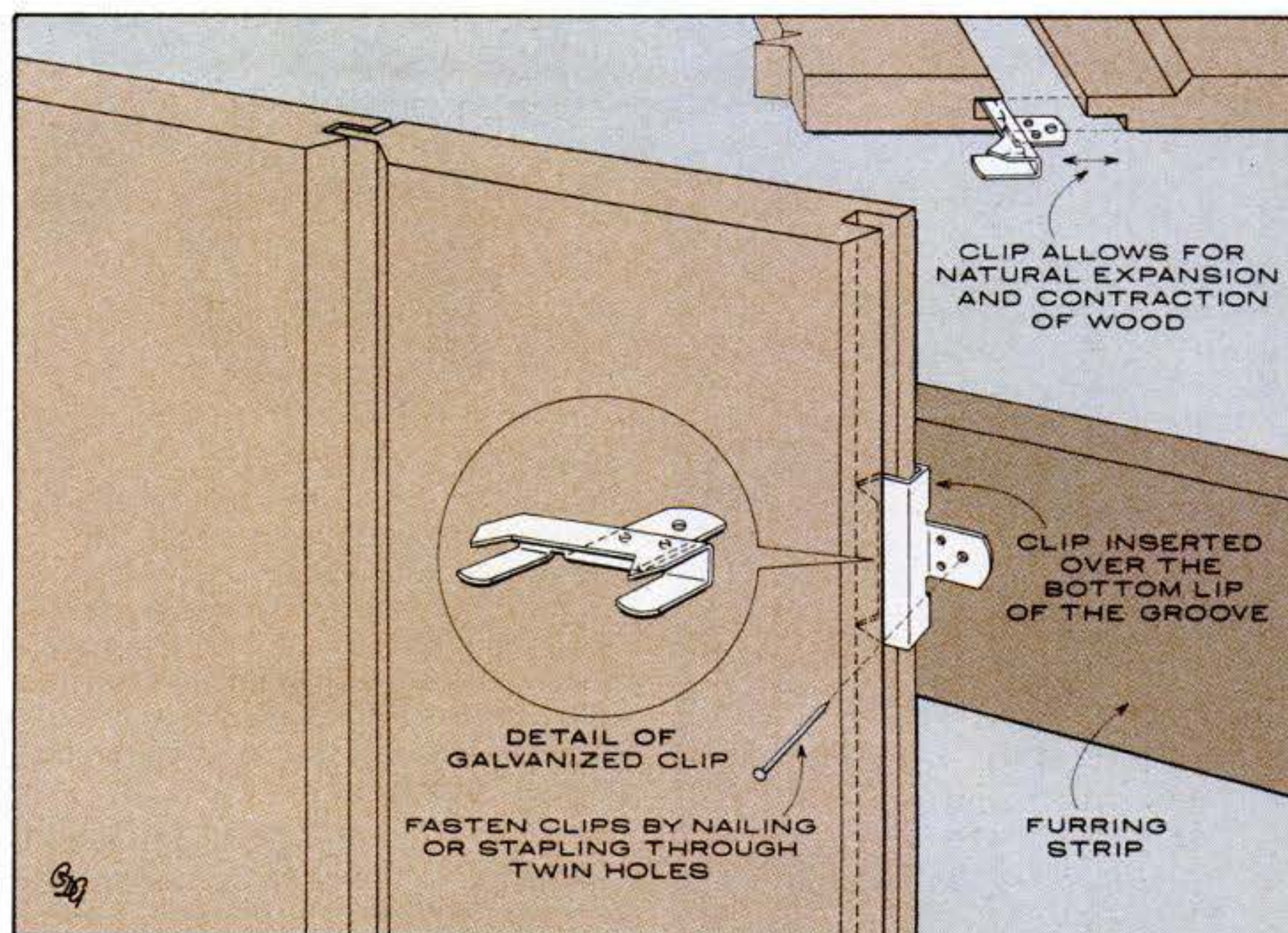
"Nailing into fine wood is like coloring on the Mona Lisa," says the maker of a German wood-paneling system that recently made its American debut.

While skilled cabinetmakers might take exception to the statement, not everyone who pounds nails into wood does it with finesse. With a five-thumbed novice at the hammer, the result can be surfaces marred with dents and wood split to splinters. Given the price of fine wood today, you can't afford to ruin even one piece.

This paneling system, designed to minimize such casualties, is called Profilewood; it's made in Tacoma, Wash., by Ostermann & Scheiwe USA, Inc. The paneling is one-half inch thick, and the wood is fine indeed. Obviously, it carries a premium price tag and qualifies for velvet-glove treatment. The clever installation system assures that it gets it.

The panels are milled to a special tongue-and-groove design, but you don't nail through the lower lip of the groove as you do with conventional T&G paneling. Instead, galvanized clips slip over the lower lip, and the nail (or staple) goes through a hole in the clip. Only the first piece of paneling need be nailed through the wood. (Masonite's Marlite hardboard paneling uses an installation system that's similar in principle, but this is the first clip-up system we've seen for wood panels.)

With clip-up installation, not only



Tongue-and-groove panels are installed with galvanized clips that slip over the

bottom lip of the groove. Clips are nailed or stapled to furring strips.

are you less likely to mar the wood, but you also have paneling that can expand and contract freely in response to climatic changes. That makes Profilewood especially appropriate for kitchens, bathrooms, spas, and other high-moisture areas.

You can apply the Profilewood paneling horizontally or diagonally over vertical furring strips or directly to wall studs. To use the paneling vertically, horizontal furring strips are required.

Or stick it up

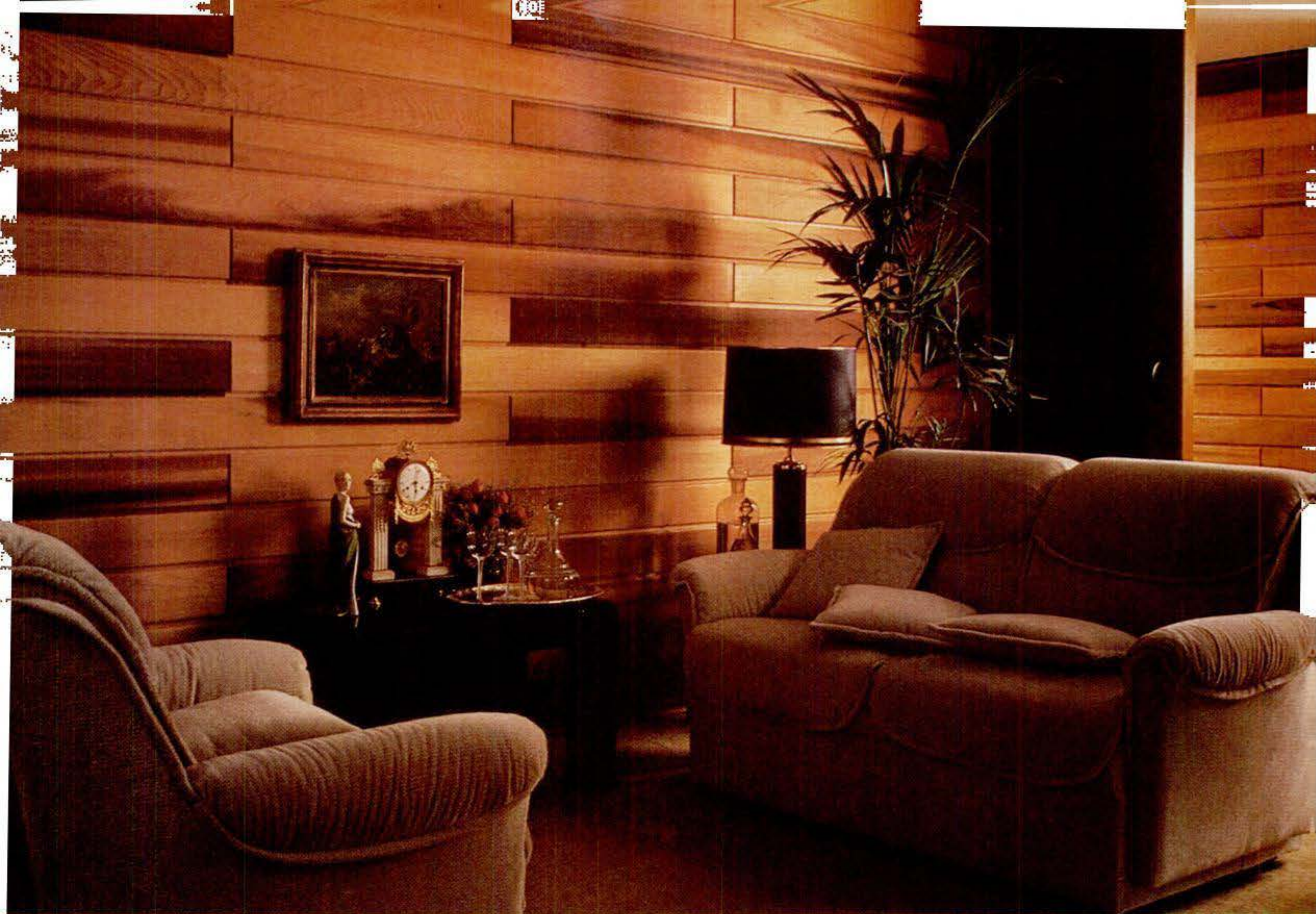
In new construction, Profilewood paneling can be put up with construction adhesive. Gluing is faster than using the clips, but the company recommends it only where the moisture level remains low, and only when

the paneling is applied vertically.

Initially, Ostermann & Scheiwe marketed Profilewood to builders and architects, but distribution to lumberyards and home centers has begun. For sale to consumers, the paneling is packaged in random lengths (from one to eight feet) with enough in a package to cover 22.83 square feet. Price of a package is about \$17 for cedar, for example.

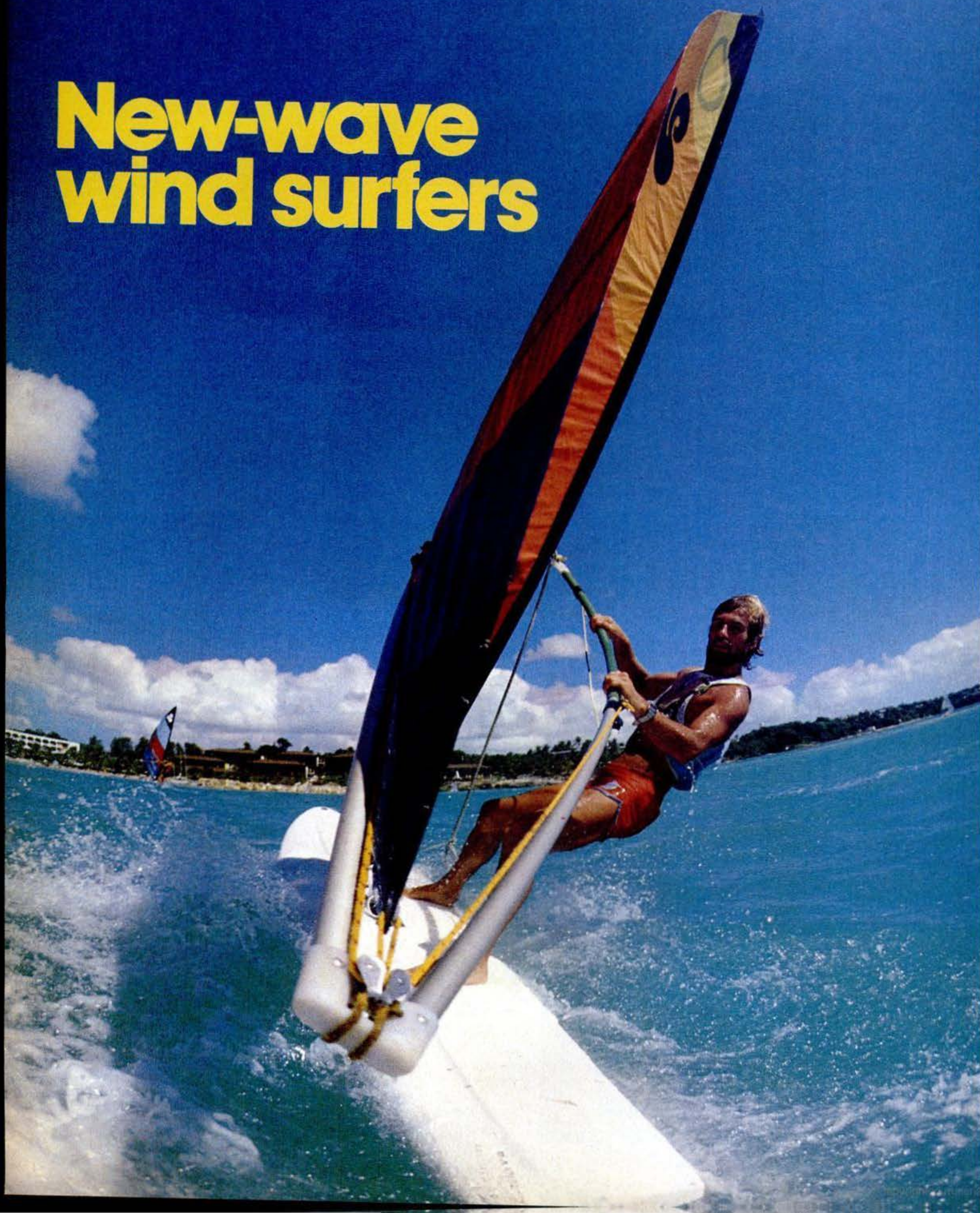
"That's approximately 25¢ a board foot more than rough-sawn cedar paneling," says a spokesman for the company, "and since there should be less waste with the clip system, the cost could end up being about the same."

For a list of current distributors, write to Ostermann & Scheiwe USA, Inc., Box 26, Spanaway, Wash. 98387.



Posh wood paneling can be used anywhere in the house—vertically, horizontally, or diagonally—on walls or ceilings. Five woods are available: California redwood, western red cedar, western hemlock, Douglas fir, and Sitka spruce. The panels can be finished with wax or a semitransparent oil stain. When used in damp areas, the paneling should be treated on all sides and on the ends with a water-repellent preservative.

New-wave wind surfers





With a dazzling array of boards available, experts suggest some buying guidelines

By SUSAN RENNER-SMITH

Suddenly they're everywhere—rocketing off ocean waves, skimming on calm lakes, careening around racing buoys. Whole fleets of new sailboards have hit the waters this year. One reason: The International Olympics Committee recently elevated sailboarding to an Olympic-class sport and scheduled the first competitions for the 1984 games. That's speedy recognition for a sport that's new to most Americans, though it was invented here over a decade ago.

POPULAR SCIENCE first told readers how to build and steer a sailboard-type boat in August 1965. By 1967, Windsurfing's Hoyle Schweitzer had developed the patented Wind-surfer design, with its wishbone-shape boom, triangular sail, and universal joint linking mast to foam-filled board.

The boards are inexpensive (\$600 to \$1,300), portable, easy to launch, and, at speeds up to 20 knots, exciting to sail. For these reasons, sailboards may finally catch on in energy-crunched America. The manufacturers are betting on it. A few years ago there were only two or three companies selling the rigs in North America. But a 1981 guide (*Sailboards '81*, \$2 from *Yacht Racing/Cruising Magazine*, Box 902, Darien, Conn. 06820) lists 29 makers offering 40 different models. You'll see flat planing boards, displacement hulls with either V-shape or rounded bottoms, and semi-displacement hulls with a planing surface aft. How do you decide which one to buy?

"A beginner should buy a flat board," suggests Nancy Johnson, a world-champion sailboarder. "It's the simplest to learn on and sail. And you can do both freestyle and regatta racing with it when you get better."

You'll also have to juggle the merits of fiberglass, polyethylene, and ABS plastic. Many racing boards have a fiberglass shell because it's the stiffest. It's also the most brittle and easiest to damage. Polyethylene is tough, but once damaged it's much harder to repair than fiberglass. ABS plastic is also tough, and can be easiest to repair. But too much sun can warp an ABS board.

Boards can fly four different-size sails, ranging in area from about 40 square feet up to 70. Windsurfing International offers a 31.2-sq.-ft. minisail. "A beginner may do better with a light rig," says Anders Bundgaard of Downwind (Nashua, N.H.). "It's easier for a beginner to pull a shorter sail out of the water, and he doesn't get as tired when learning."

Whichever board you choose, don't buy it without getting a lesson. All experts agree you should not just hop on a board and expect to sail off. "Sailboarding is similar to skiing. If you strap on some skis and head to the top of a mountain to teach yourself, you're in trouble," comments Downwind spokesman David Brown. Most lessons have two parts—a session on a landbound simulator, then an in-water session [PS, Feb. '77].

"We put them on a nice, extra-wide board," says Nancy Johnson, who's a certified Windsurfer instructor. "By the end of two hours they're sailing around." [S]

Slicing through the surf: Porsche sailboard's semi-displacement hull handles waves easily (facing page). Designed by the noted automobile stylist, the board is imported by Sailboard, Inc., of Boston. Another import, the Dufour Wing (top left) holds an unusual record: It's the only sailboard ever to round Cape Horn. The original planing board, the high-flying Wind-surfer (left), is available from dealers nationwide.

Earth-sheltered two-story



By AL LEES

Notched into a low rise, this clever design gives you many of the energy-saving benefits of an underground home plus those of a passive-solar home—and without any loss of view. Ideally, your slope should rise to the north so that the heavily glazed patio and bedroom walls—and the skylighted living-room roof between them—are sited due south.

You enter this house—whether by foot or by car—on the upper level. As shown in the smaller rendering on the fac-

ing page, windows are kept to a minimum on this single-story north wall, even though they're double glazed. Compare that rendering with the section on this page to see how both the garage and the earth itself buffer the living areas from winter blasts. Note, too, that all side walls are windowless.

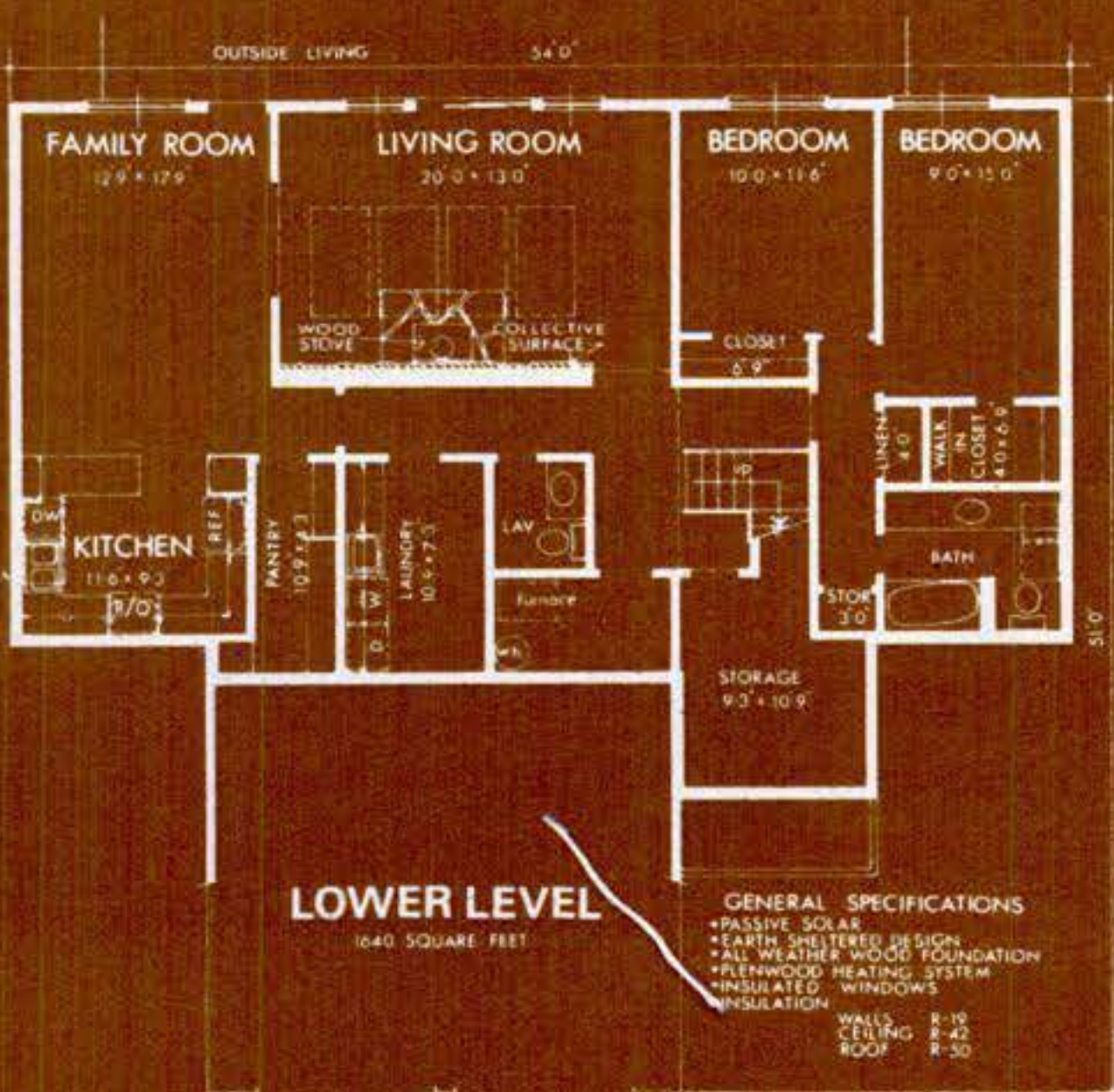
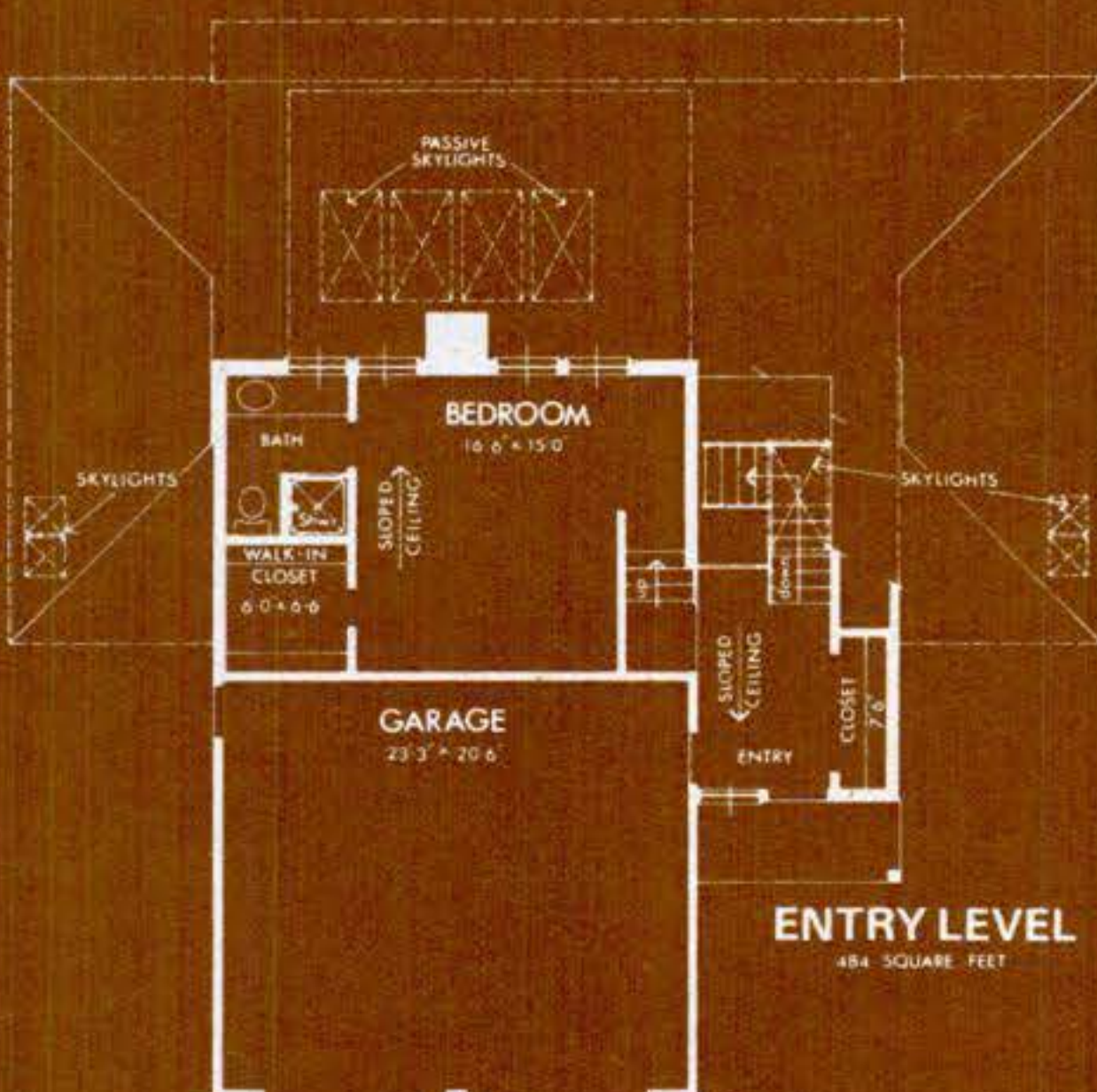
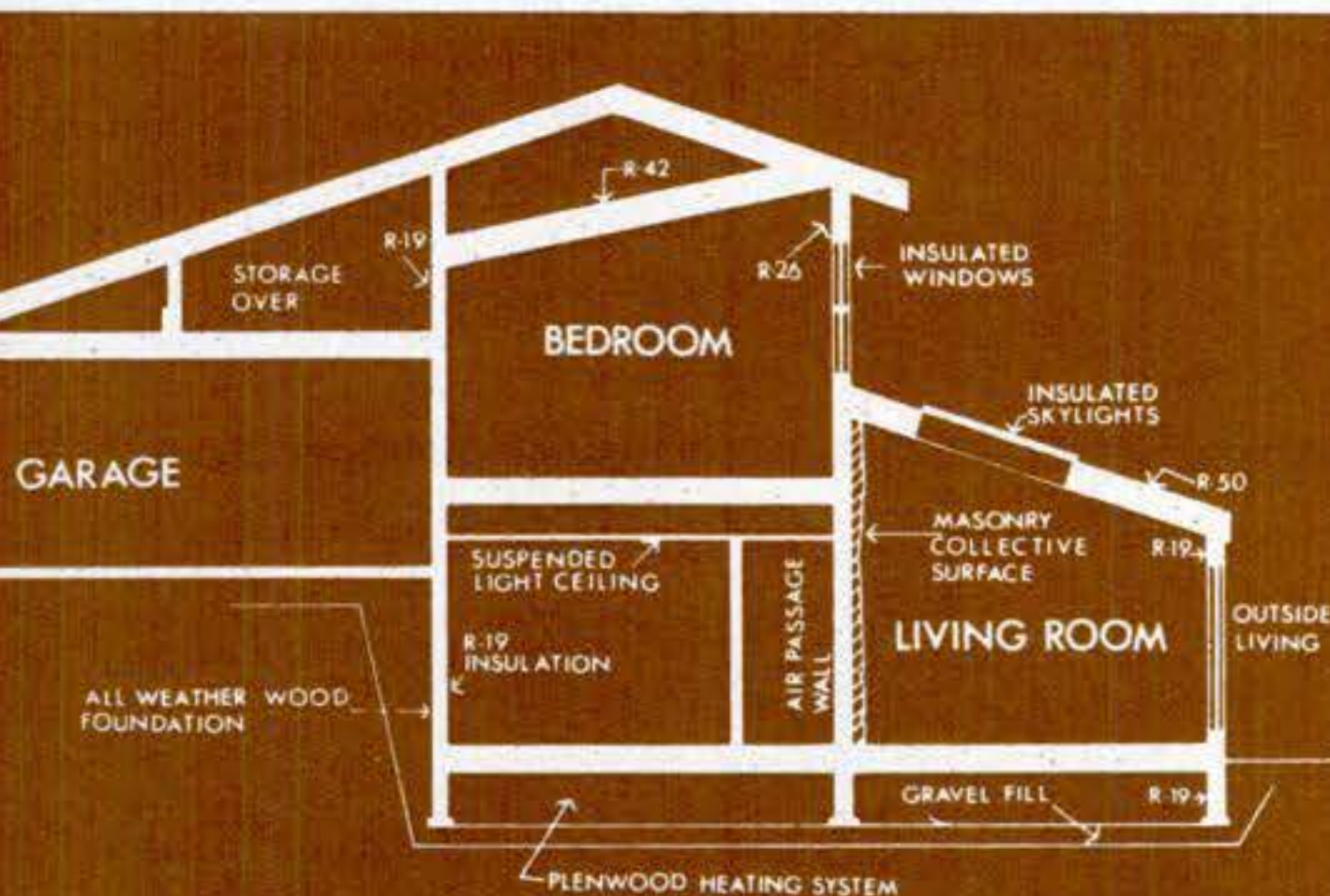
Why are earth-sheltered houses energy efficient? Because soil protects the walls from outside temperature fluctuation and the effect of either cold or hot winds. While earth is not much of an insulator, it's a fine temperature moderator, and so helps earth-sheltered walls stay warm in winter and cool in summer. Combine this with controllable passive solar features and you have a home that requires minimal heating and air conditioning.

The south wall maximizes solar gain all winter, and four large skylights above the living room let the low winter sun "bake" the stone wall behind the wood stove so heat will radiate from it long after the sun has set. All this works well with the built-in Plenwood heating system [PS, Jan. '77], which uses an insulated space under the main floor as a plenum to distribute heat from a small floor furnace to registers in the downstairs rooms. The central wall of the house is hollow and carries heat to the master bedroom from both its rock storage face and the plenum surrounding its base.

The earth-sheltered foundation walls that form the perimeter of this plenum are built of plywood and lumber that have been chemically treated against rot—a dramatic use of the All-Weather Wood Foundation we've often touted in PS. Both it and the Plenwood system (which also air-conditions this house) are now recognized by model building codes throughout the country. Though both systems require careful construction with pressure-treated materials and with attention to proper site drainage, they require no special construction skills and can be tackled by do-it-yourself carpenters (see box below).

Earth-sheltered homes must be carefully designed for good lighting: Here, living room, family room, and all three bedrooms have ample window area. The kitchen and bath in the earth-sheltered corners have insulated skylights; the kitchen also boasts a luminous ceiling. The other rooms backed against the excavated slope are for storage and utility.

This is another in a series of passive-solar plans designed for PS by Ken Gephart of Home Building Plan Service in cooperation with Western Wood Products Assn. Natural woods are used effectively, both outside and in. The cedar-board siding follows the roof angles, and solid-cedar shingles add pattern to the roof planes. PS



Further data on the wood foundation

"Introducing the 'Non-Basement' Basement" is a folder about the All-Weather Wood Foundation system. It's published by American Plywood Assn., P.O. Box 11700, Tacoma, Wash. 98411 (\$1; ask for D415). For a technical manual on the Plenwood heating/cooling system, send 50¢ to Western Wood Products Assn., Dept. SP-7, Yeon Bldg., Portland, Ore. 97204.

How to order your plans

One set of professionally drawn plans for this house is \$100; four sets (for building, financing, and permits) are \$140. Plans can be reversed (left to right) for an additional \$20; materials list is \$20; typical plumbing and electrical diagrams are \$7.50 each. To use your MasterCard or Visa (for plans orders only) call toll-free 1-800-547-5570. Or send check to Home Building Plan Service, 2235 N.E. Sandy Blvd., Portland, Ore. 97232. Specify plan 944-1A. From the same address, a special offer for PS readers: Three plans booklets (*Homes for the 80s*, *Hillside Homes*, and *Recreation and Holiday Homes*), regularly \$3 each, for \$6.

Now's the time to **patch up the driveway**

Edging heaved? Or you don't have any? Set a line of blocks before patching

By **SAL TRIOLO**

If you need any reminder that you've gone through yet another winter, take a look at your driveway. The pot-holes, cracks, and heaves will tell a story about the past season's cold, destructive months.

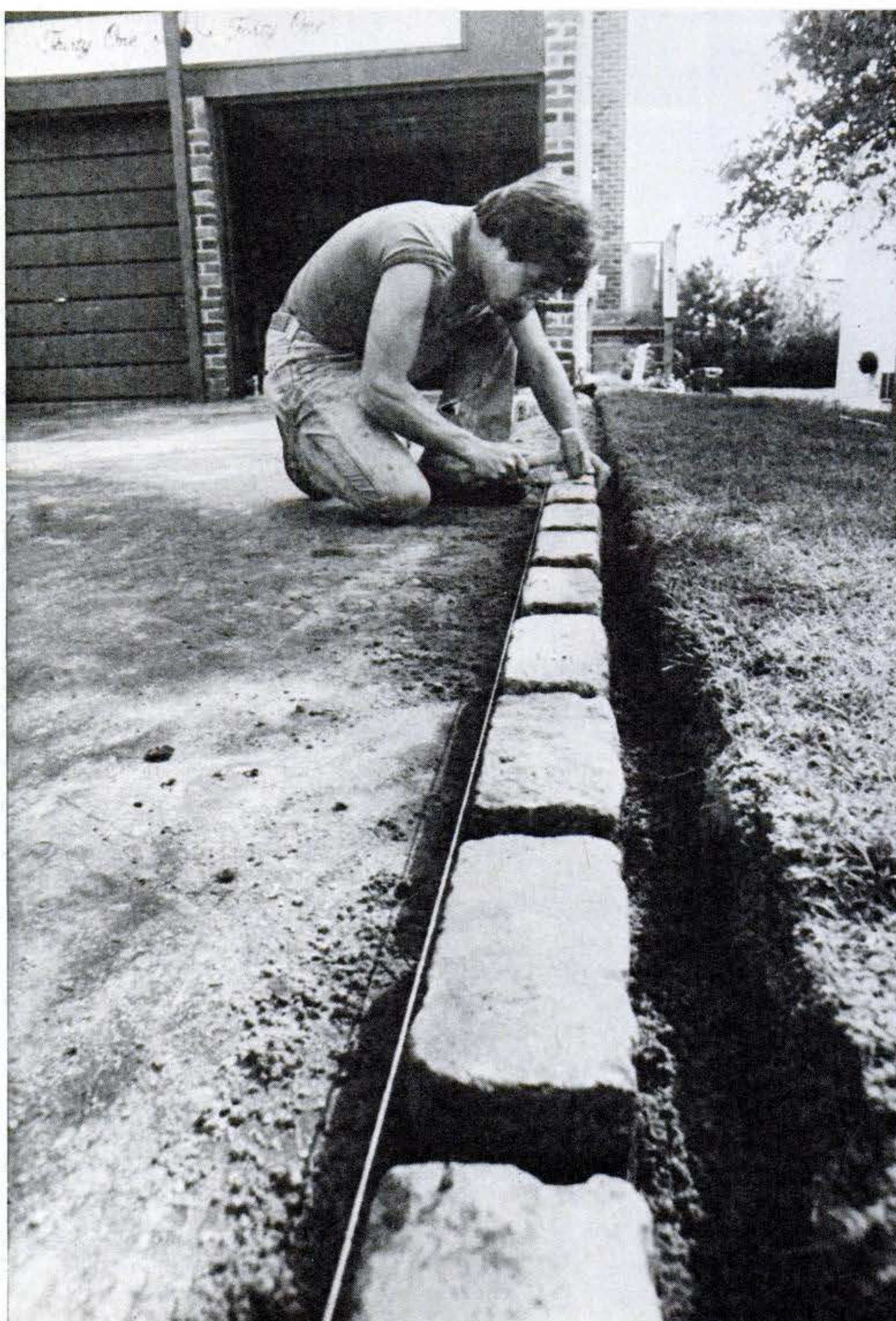
And, if you've edged your drive with blocks, there's a good chance that they, too, will require repair. Cracks here mean loose—potentially hazardous—footing for your family. No blocks along your driveway? Now's the time to put them in—before the asphalt is patched and resurfaced.

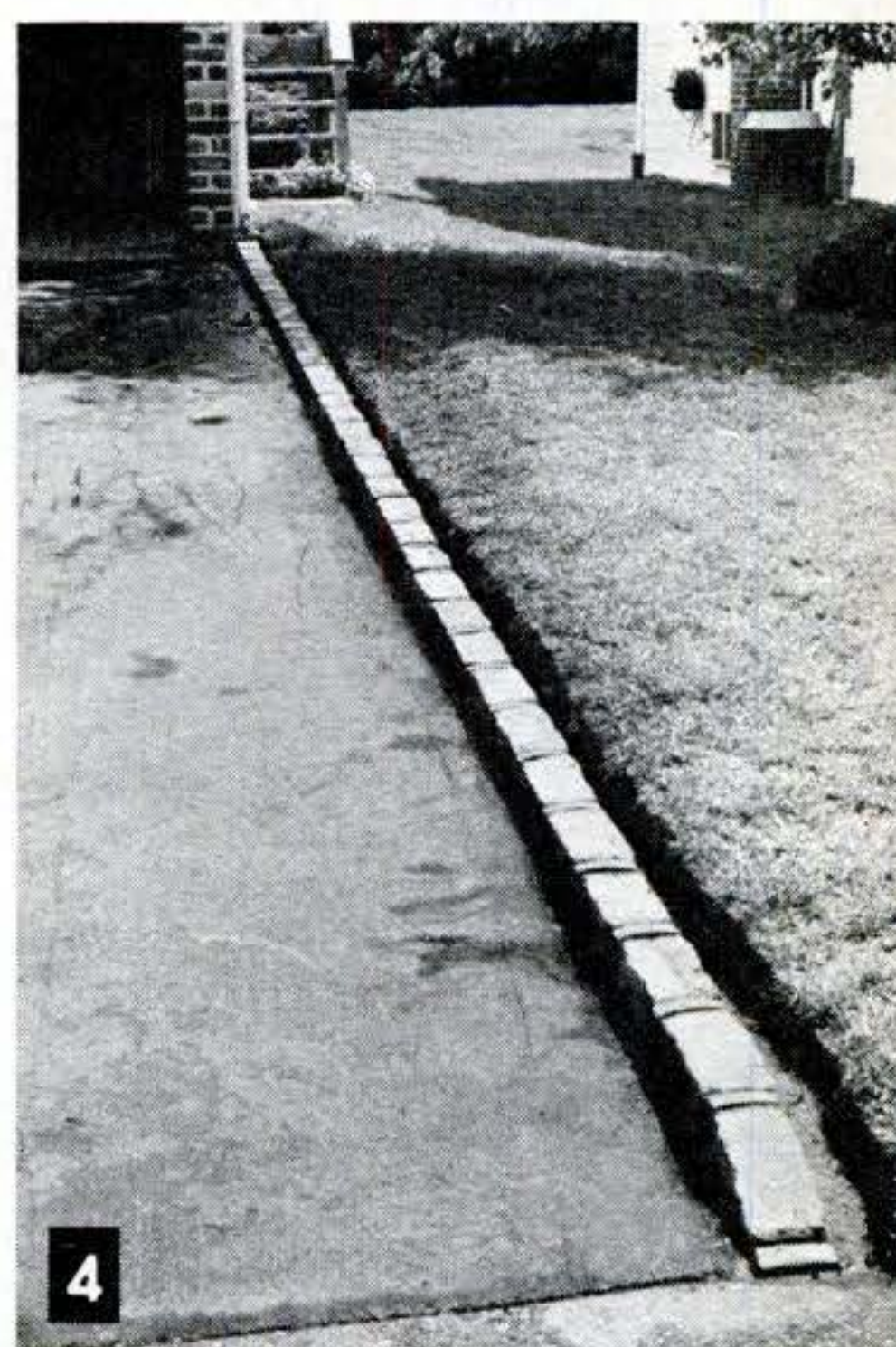
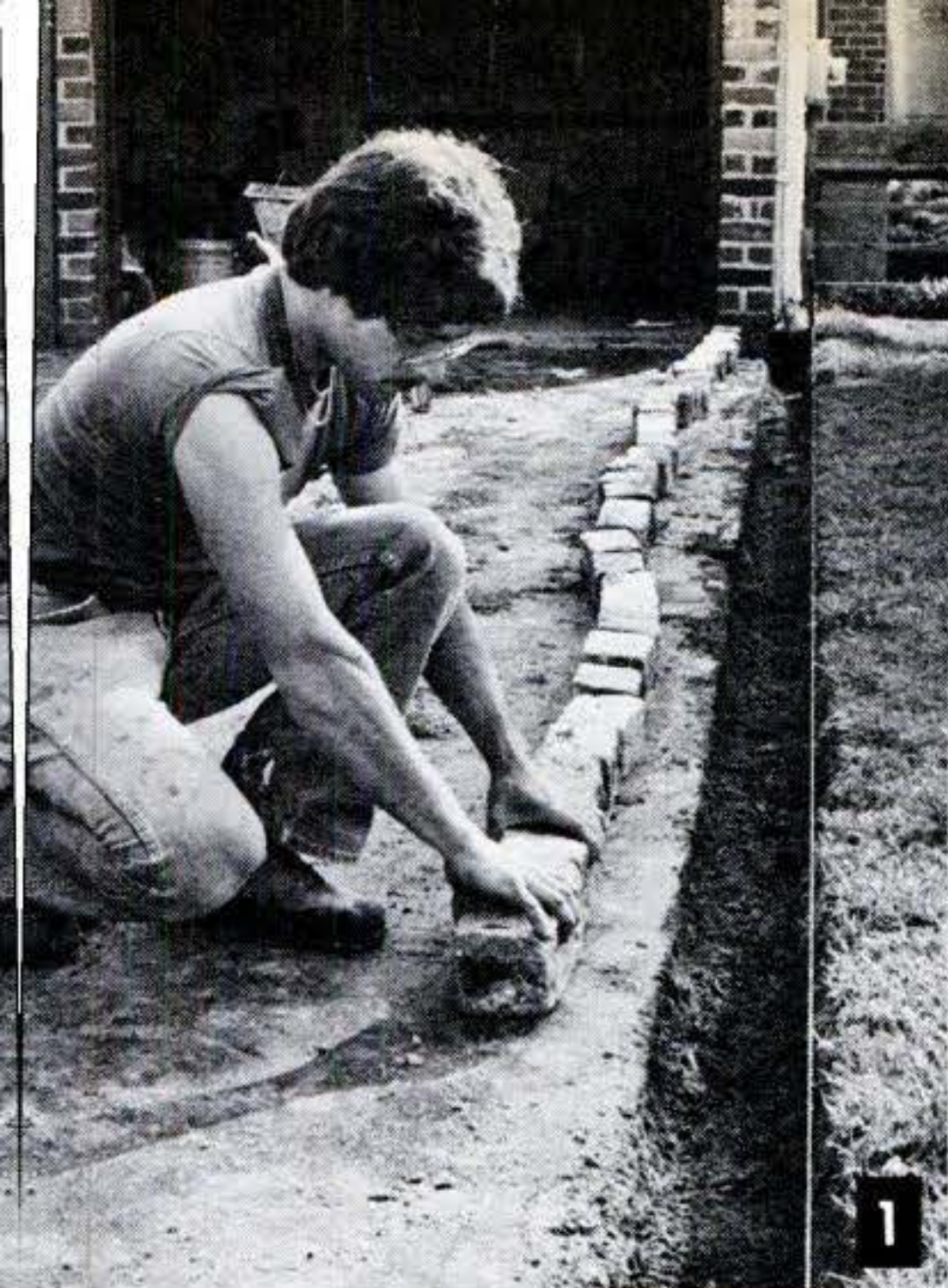
To the eye, cobblestones (or, as in this instance, Belgium blocks) help straighten a generally ragged-looking asphalt driveway edge. But they do more: Your lawn isn't slowly eroded from runoff and, for lawn care, the blocks make edging a snap.

Installing the blocks—or repairing the ones you have—takes little work and requires only a few tools. It does take patience, however, as the accompanying photos illustrate. Each block must be properly chosen for its spot, then cleaned and aligned. Use a taut line, of course, but use your eye as well when you set them into the concrete.

Once the concrete has set, you're ready to begin the asphalt repair. You may be able to rent the tools shown (butane torch, tamper, and squeegee-like spreader) where you buy the patch and sealer. **PS**

Stake a taut line down length of drive and cut a straight, smooth trench with a pick-ax. Line blocks up at trench's edge to judge final effect before setting them.





Repairing an asphalt driveway



Hole is cleaned out, overfilled by an inch with asphalt patch. Butane torch melts patch into hole. Heated tamper (at right in



left photo) smooths patch level with surface. Patching is completed with latex-based sealer spread over entire drive.

Existing blocks had been worked loose by frost heave in author's case. All were lifted onto drive so the trench could be recut and deepened for mortar bed (1). Author also took this occasion to rearrange order by size, using smaller blocks at bottom of drive, working up to larger ones near garage. Turn each block smooth side up, straighter edge toward driveway. Smooth in a layer of concrete and use a lump hammer to set each block firmly in place (2). In setting the first block at the sidewalk or curb, the outer end is driven deep into the fresh concrete to avoid a sharp nose, which would be hazardous for walking or driving. A level will help you set all subsequent blocks flat and at identical heights. Space them one to 1½ in. apart, depending on the thickness of the mortar joint you prefer (3). Overfill each joint with mortar mix (as shown at right in photo), then crisply strike off each side with a cutting trowel until it looks like the joint at left. Slight gap along lawn side of block line (4) makes edge-trimming easier.

4-in-1 backyard center

These trim modular units can be customized to your own outdoor activities

By SUSANNE STEVENSON
DESIGN BY PETER STEVENSON

Versatility is the key to our multi-purpose backyard center—a unique concept for organizing outdoor activities. The modular design offers flexibility so you can adapt the unit to your family's needs.

The unit we built and photographed has four separate work areas: a cold frame/mini-greenhouse; a barbecue; a potting bench with sink; and a storage cabinet for outdoor equipment. You can copy our design by building one of

each of the four units, or you could double up on some and omit others—for example, join two storage areas, a barbecue, and a cold frame. Each module could also be an independent structure, stood against a fence or wall if you don't have enough yard space for the full assembly. Each of the counters has a generous 30-by-42-in. work area.

The potting area has a latticework surface that simplifies collection of spilled potting soil—just put a tray or basin on the shelf underneath for a neat catch of any overflow. Water from the sink next to the lattice counter makes potting easier (it's also handy for watering seedlings in the cold frame). Two large storage cabinets below complete this module.

The mansard equipment shed has room for large implements, such as

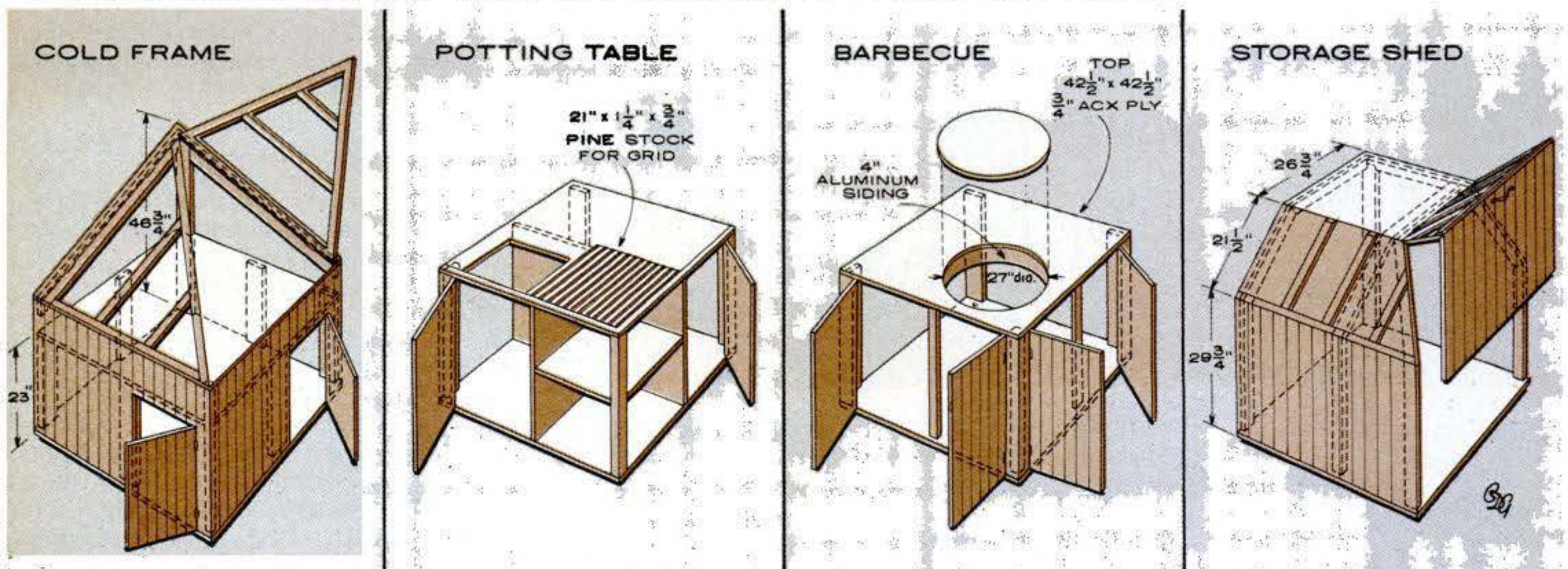
mowers, as well as bulky yard supplies. The unique hinging of the top and side allows easy access to all the storage space.

The easy-opening wing-shape roofs of the cold frame/greenhouse make tending seedlings a snap. The tops are made with inexpensive polyethylene stretched over pine frames.

The adjacent barbecue counter is designed to hold everything you need for cooking and serving. A 27-in.-dia. hole in the center is ringed with aluminum and takes a standard grill. There's also a storage area underneath for charcoal and cooking utensils. When not in use, a cover fits over the barbecue opening to keep it out of the weather (and out of sight).

Construction is easy; the caption below gives details and tells how to order a plans packet. **15**

Complete plans let you build full assembly or separate modules



Sections of the backyard center measure 30 by 42 1/2 inches with T 1-11 exterior plywood as siding and doors. Horizontal work surfaces are 3/4-in. ACX (exterior) plywood. Wing-shape tops of the cold frame are made of 3/4-in.-by-1 1/4-in. pine strips with six-mil polyethylene stapled on the underside. The "mansard-roof"

storage area has a double-hinged side and roof of 1/2-in. ACX ply with 1 1/4-in.-wide decorative strips tacked on. The cruciform center frame is built of 2x4's, covered with 1/2-in. ply and capped with redwood 1x6's. For detailed plans send a check for \$7 to Stevenson Projects, P.O. Box 584, Dept. B85, Del Mar, Calif. 92014.



Backyard center in action: planting at the potting bench (top), broiling on the barbecue (left), and cultivating in the cold frame (above). Sloped-roof storage cabinet stands to right of the cold frame. Water for the potting table's sink can be plumbed underground or supplied via a garden hose. The drain can simply empty into a gravel-filled hole in the yard. A concrete slab, mortar blocks, or just gravel will provide an adequate foundation.

Air tools

put pro muscle in your shop

Low-cost, lightweight pneumatics give you smooth power that's easy to control

By **TOM WILSON**
and **RICHARD DAY**

Pro mechanics and trades people long have flexed pneumatic muscles. Why shouldn't you too enjoy the benefits of air tools? They're lighter and generally more maneuverable than electrics of the same power. Air-vane motor power is more controllable. An air tool is unharmed by overloading, even by a dead stall. And it seldom overheats. Besides all this, you'll find air tools that you can't duplicate as electrics. And to make the switch still more attractive, prices of do-it-yourself air tools have been dropping. Here's a complete rundown on air tools: what's available, what they do, and what they cost.

If you have a suitable air compressor—piston type of $\frac{1}{2}$ hp or preferably more, with air tank and pressure regulator—you're on the way to assembling an air-tool shop. That's the big cookie. (If you're starting from scratch, we'll give you tips on compressor selection later on.)

Two kinds of air tools

As you shop, you'll find two types of tools: air power and pressure. One type of air-power tool uses an air-vane motor: Air expanding between two vanes turns a rotor. Gearing and other mechanical action provide rotary or reciprocating action. Air-power tools can also be piston powered, with a piston, cylinder, and valve—much like a steam engine. An air-pressure tool does its work like a spray gun, blow-



Automobile-engine cylinder-head port is polished with an air-powered die grinder.

ing something out along with the air.

Air drill. This is perhaps the number-one ambassador of air tools. Super lightweight and with an infinitely variable trigger throttle, it does any job handled by an electric drill—but better. The drill's trigger instantly varies drill speed and power from a creep to full bore. Maximum torque is always available, even at stall.

To experience the control of an air tool, start a drill bit without center-punching first. With an electric the expected happens: The bit wanders away from your mark. But with an air drill, you start so slowly and smoothly that the drill makes its own start-up hole, right on target.

Paint spray gun. If you already have a compressor outfit, it's likely a paint spray gun came with it. The \$35 convertible bleeder/nonbleeder, internal-

mix/external-mix, siphon-feed/pressure-feed spray gun that comes with many compressors is great for around-the-house painting in enamels and latexes.

A bleeder spray gun, used only with a tankless air compressor, emits air continuously from the air supply. Nonbleeders emit air only when you pull the trigger. They are used with an air line and air-storage tank. An internal-mix spray gun blends air and paint inside the gun's nozzle, while an external-mix blends outside the nozzle. The internal-mix gun is best for slow-drying paints; the external-mix is best for fast-drying ones. Siphon feeding is used to break up hard-to-atomize paints like lacquers. Pressure feeding lets the gun lay on more material quickly, as you'd want for house painting.

A convertible gun, while it can be

changed to suit a variety of paints and projects, lacks the finesse to put down a really smooth finish. For fine finishes on cars or furniture, use a top-of-the-line, \$100-plus, external-mix spray gun. Such guns are built with the quality, controls, and size for professional work.

Hammer-chisel. An air hammer-chisel is just the ticket for muffler and body/fender work. Long, arm-tiring hammering sessions are compressed into a few seconds by the hammer-chisel's piston-delivered blows—some 2,000 a minute. A small packet of bits will handle a large packet of projects. These include nut busting, dent pulling, riveting, metal forming, slitting, and pipe splitting. Get the longest-bodied air hammer-chisel you can afford. Unhappily, the economy-priced \$39.95 unit we purchased had such a short stroke as to be practically useless. The farther the piston moves, the harder the bit will strike.

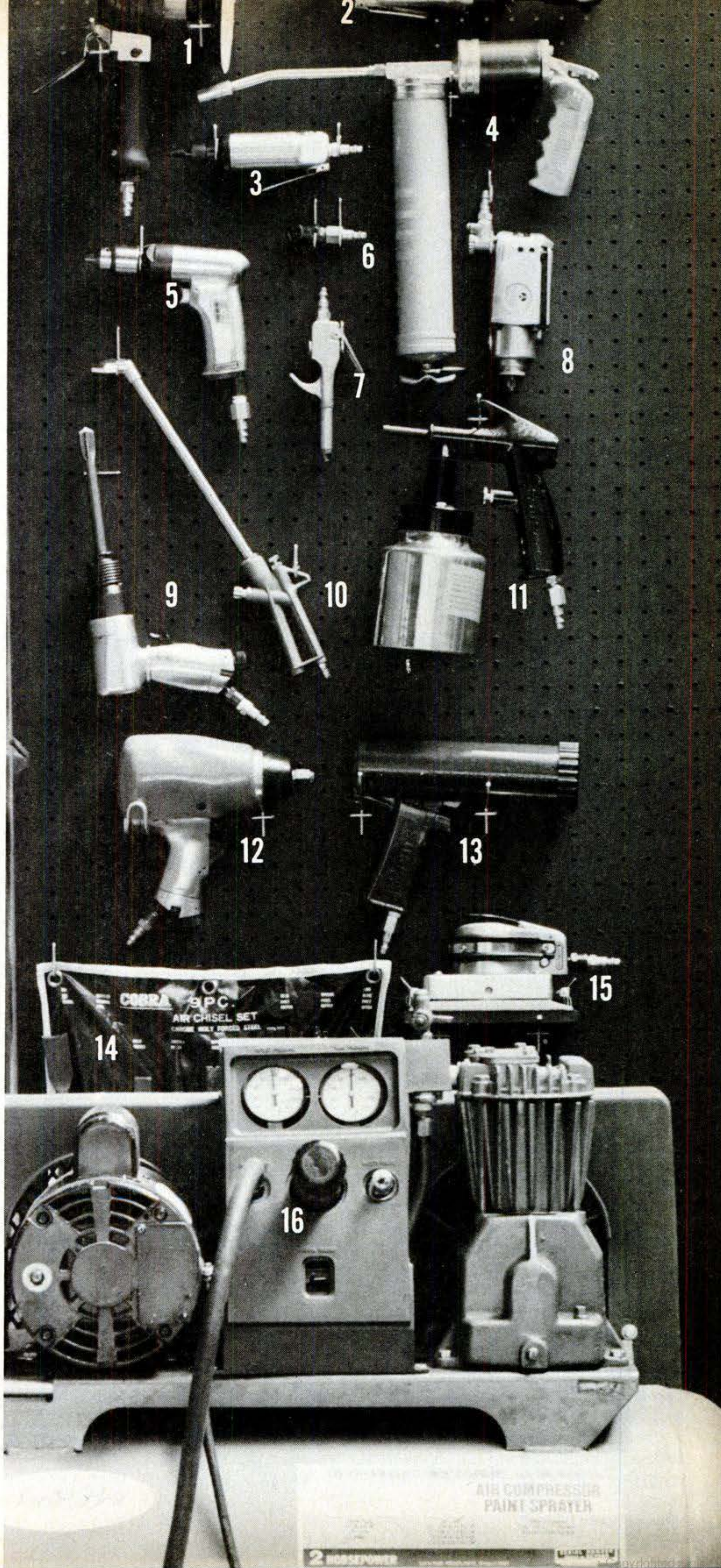
Safe use of an air hammer-chisel calls for adequate eye protection. And when installing or removing a bit, always disconnect the tool from its air source. Accidental triggering would send the bit flying. Likewise, always firmly install the bit retainer before connecting the gun back to its air.

Die grinder. If you do much precise grinding or polishing on such things as auto-engine cylinder-head ports and valve reliefs, cleaning tight welds, or pipe deburring, the ultra-high-rpm die grinder is for you. Wailing happily at 23,000 rpm, the die grinder spins 1/4-inch-shank cutting bits and burrs as well as polishing cones. Just be sure that the bits you use can withstand the high rpm. A shattering stone scatters its pieces with high velocity.

Needle scaler. Another metalworking tool is the needle scaler. It does much the same job as a sandblaster, but doesn't scatter abrasives. A needle scaler will scour the rust out of extremely irregular surfaces. It works with an internal piston, as on an air hammer-chisel. But with the scaler, a set of hard metal needles is shot onto

Continued

Air tools displayed at right were purchased for less than \$50 apiece. (If you're planning heavy use, it's best to pay a little more.) The tools are: (1) dual-action random orbital-disc sander; (2) ratchet socket wrench; (3) die grinder; (4) grease gun; (5) 3/8-in. drill; (6) tire-inflator chuck; (7) blowgun; (8) 3/8-in. palm-sized impact wrench; (9) hammer-chisel with bit; (10) engine-cleaning tool; (11) sandblasting gun; (12) 1/2-in. impact wrench; (13) caulking gun; (14) hammer-chisel bits; (15) orbital-pad sander; (16) air compressor.

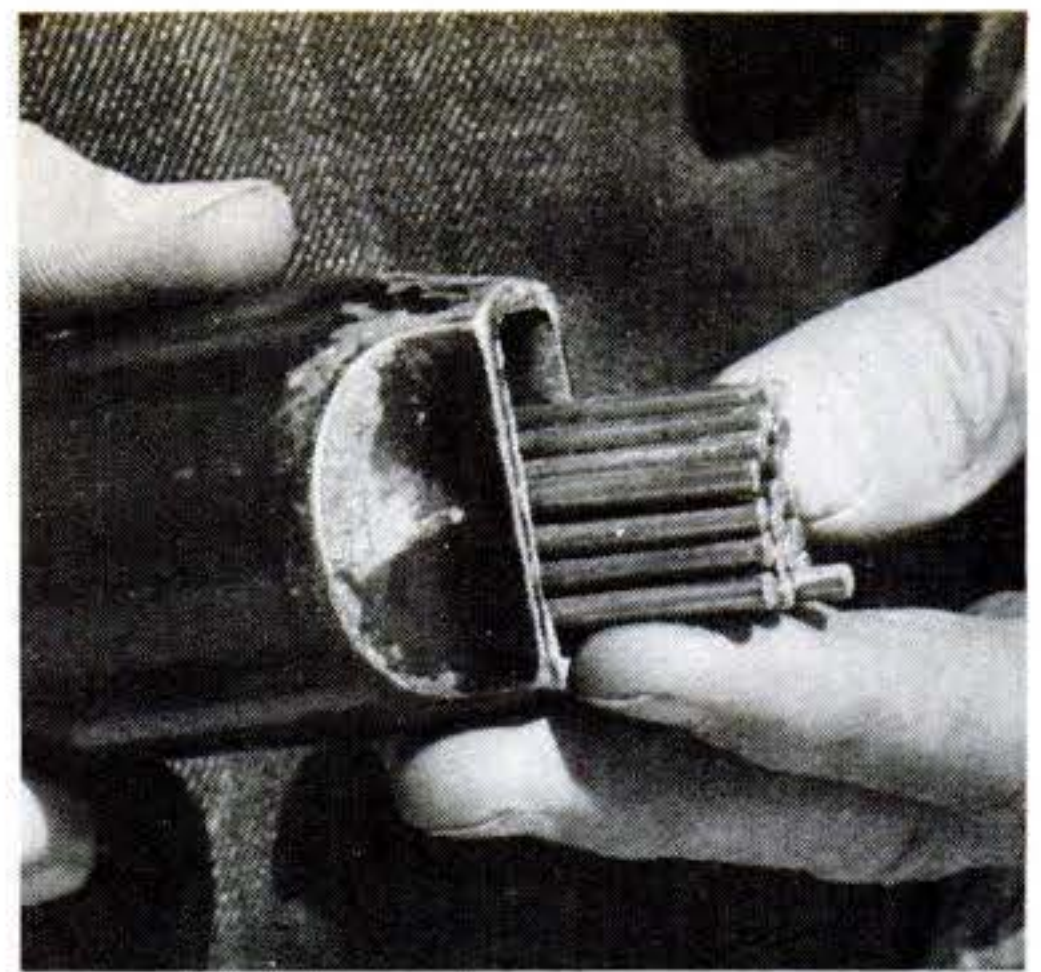




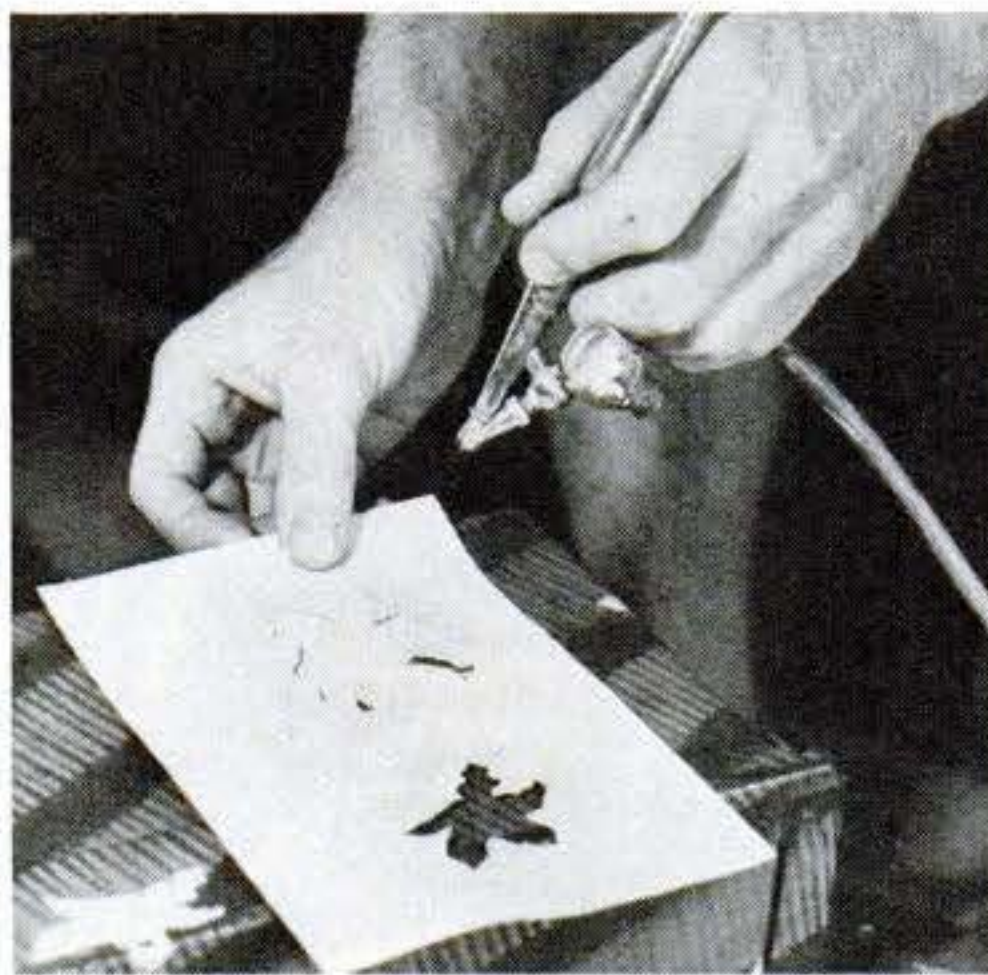
Swimming-pool repair in water—hazardous with electric drill—is safe with air-powered tool. Hose reaches from compressor, wheeled to poolside for use.



Sandblasting gun has innumerable uses around the house and garage. Here it's used to clean oil-fouled spark plugs. Protect your face, hands, and lungs.



Needle scaler has hardened-steel captive needles at business end. Needles vibrate against the work to remove heavily encrusted paint and rust in corners.



Artist's airbrush is handy tool for spraying small amounts of paint. Stenciling rig shown was fed from CO₂ bottle with regulator and gauges for on-off use.



Sandpaper polishing cone is one of many useful die-grinder options. Cone threads onto its arbor and stays until removed. Layers of paper extend cone life.

the work at up to 5,500 times a minute. The needles conform to whatever shape is there, chipping the surface away to something solid. Needle scalers are great for removing graffiti from masonry buildings or for auto-shop and welding work. They do leave the surface rough, however.

Air wrenches. These are the most basic of air-powered tools. Handiest of all is the compact $\frac{3}{8}$ -inch-drive impact. You'll love it. Small enough to fit the palm of your hand, it packs up to 75 foot-pounds of torque, enough for most jobs around the house and garage. A two-way butterfly throttle lets you tighten or loosen, depending on which way you press it. A wide assortment of sockets and screwdrivers and other accessories is available. All should be of tough impact design.

The $\frac{3}{8}$ -inch impact wrench will not handle big jobs such as car-engine cylinder-head bolts or wheel lugs. For these you need a $\frac{1}{2}$ -inch impact that will twist 200 foot-pounds and more.

The air ratchet is another handy air wrench. Since it does not impact, it transfers torque to the user. This is

actually a help in judging how tight the fastener is getting. An air ratchet can also be used to hand-tighten a fastener that has been run down under air power. Impact hardware need not be purchased; use the air ratchet with standard sockets ["Power Wrenches," PS, Aug. '78].

Grease gun. An air-powered grease gun is made for those who do their own auto-lube work. It will take only a few lube jobs to save the tool's under-\$35 cost. An air greaser takes the standard 14½-ounce cartridges of various types of grease. It also accepts bulk grease loads, though you'll get greasy loading it. The gun pumps out grease at up to 9,000 psi.

Air sanders. If you're involved in auto-body/fender work or furniture finishing, look at the nifty air sanders you can use. Most basic is the orbital-pad sander, sometimes called a finishing sander but also great for rough sanding and feather-edging. The air model easily tops electrics. It's so small you can do single-handedly what you'd want both hands for with an electric model.

Another air sander that some in

auto-body repair prefer is the random-orbital-disc sander, also called a dual-action (DA) sander. Fitted with a seven- or nine-inch sanding pad and disc, it not only spins as a normal sander does, but moves the pad laterally to create a random-orbital finish. The uses for it are the same as for the orbital-pad sander, though it's heavier and harder to control. You probably wouldn't need both sanders.

The air disc sander is great for grinding down old paint, removing rust, and preparing metal for painting. It thrives on tough going. And if you make a set of progressively smaller pads, you can use sanding discs right down to the nubbins.

Caulking gun. The homeowner who has suffered forearm fatigue from working with cold, balky caulk will appreciate the air-powered caulking gun. It's a low-ticket air tool costing about \$15. Air power takes the strain out of applying caulks, sealants, and adhesives from the familiar 11-ounce drop-in cartridges.

Trades tools. In addition to the most popular air tools, you'll find a number of more specialized ones, such as air



In-line oiler fitted to inlet of air tool meters small amounts of lubricating oil as tool is used. Cost is about \$12. Oil from the device may contaminate some finishes.



Air-supply hose with swivel head is called a whip; it lets tool work in tight spots. This \$12 model is fitted with quick-coupling male adapter and control valve.

nailers and staplers, used in the building trades. Most often these are supplied with pressurized gas from a high-pressure portable tank with gauge and regulator. The tank, with a short hose, is carried near the work site. Tank-filling, once you have the tank, costs little, considering how far a tank goes. These tools may also be supplied by an air compressor.

Air-pressure tools

Some air tools do not develop torque or impact power; they spray. For use with an air-storage tank, all of these should be of the nonbleeder type—that is, air flows only when you trigger the tool.

Sandblaster. This is one of the foremost air-pressure tools. Once you have it you'll wonder how you got along without it for scouring off rust, removing paint, etching glass, cleaning concrete (great for graffiti), and texturing wood, among other things. You can also use a sandblasting gun to spray liquids, though a paint spray gun works better for this. The sandblast gun throws a stream of silica sand or other abrasive at whatever

Table A: Air tools for the home shop

Tool	Air requirement (scfm)	Pressure requirement (psi)
Artist's airbrush	1	5-50
Blowgun	1-6	30-90
Caulking gun	1-2	40-70
Circular saw	8-18	90-125
Cleaning gun	4-6	90
Die grinder	4-18	90-125
Drill (3/8-in. chuck)	4-6	90-125
Grease gun	3-4	30-150
Hammer-chisel	4-7	90-150
Impact wrench (3/8-in. drive)	2 1/2-3	90-120
Impact wrench (1/2-in. drive)	3 1/2-5	90-120
Inflator chuck (tire)	1 1/2	60
Nailer	5-10	90
Needle scaler	3-4	90
Paint spray gun	1/2-11 1/2	10-70
Polisher	20	100-125
Pressure washer	8 1/2	40-90
Ratchet socket wrench	8 1/2	90-125
Riveter (hydraulic)	1-2	85-110
Router	8-10	90
Sandblasting gun	2 1/2-6	30-90
Sander (belt)	8-10	90-125
Sander (disc)	4-8	90-120
Sander (orbital pad)	4-7	90-120
Sander (random orbital disc)	2-9	40-100
Sander-filer (straight line)	6-8	90-125
Saw-file	4 1/2-6	80-120
Screwdriver	2-6	90-120
Shears-nibbler	3 1/2-8	90-100
Stapler	1 1/2-6	90
Vacuum cleaner	8-10	90-125

Table B: Capacities of home-quality air compressors

Compressor size (hp)	Power	Typical voltage requirement	Typical air delivery (scfm @ 90 psi)
1/2	Electric	115	1.2
3/4	Electric	115	1.7
1	Electric	115/230	3.7
2	Electric	230	6.0
3	Electric	230	6.2
3	Gasoline		3.5
4	Gasoline		7.5
5	Gasoline		9.5

you aim it. The sand is held in a quart cup or a larger accessory hopper. (Air use is increased slightly with the hopper.) The gun sells for \$30-\$40.

Depending on grit used—No. 30 is average—the texture of the parts being sandblasted can be varied from cat-tongue rough to silverwear smooth. Mandatory equipment for sandblasting is face mask, gloves, and dust respirator.

Bleeder-type sandblast guns can usually be converted to nonbleeder operation in a few minutes; the same is true for conversion between pressure- and siphon-feed tools. With pressure feeding you get more sand; with siphon feeding, less. As with sandpaper, high grit numbers become progressively finer. You can buy aluminum oxide grit for heavy sandblasting jobs; glass beads give metal, wood, and glass a fine polish.

Cleaning gun. A different sort of spray gun is the cleaning gun, or engine cleaner. Cost is under \$30. While air flows through, a siphon tube brings up solvent, such as degreaser, from a container on the floor. The solvent may be nothing more than diesel

fuel or soapy water. One of the mix-with-paint-thinner degreasers is ideal for degreasing car engines, lawnmowers, and such. These are low enough in cost to spray with some abandon. You rinse with water from a garden hose.

Pressure washer. Another kind of spray cleaner works directly with a garden hose. Air pressure speeds hose water from the tool, as though you were using a 10-cent-a-minute jet-spray, carwash tool. The pressurized water encourages dirt and grime to let go, and some units have a built-in detergent dispenser. Pressure washers cost \$80 and more, but they have many uses around the house and garage, so one might pay off faster than you'd think.

Blowgun. This is a super-useful tool. It cannot be topped for shop dusting. You can use a blowgun for drying parts, blowing out pipes, getting leaves out of a boat, overhauling a typewriter, and much more. For all its simplicity, a blowgun is among the most dangerous of air tools. The Occupational Safety and Health Administration (OSHA) has devised a new, safer design.

The problem is that high air-line pressure, when fed through the tiny blowgun nozzle, builds physically damaging pressures, especially if held in contact with the body. The new-design blowguns, which most now are, feature a hold-off end that prevents direct contact and reduces end-of-gun pressure to 30 psi when held against a surface.

You can get a similar effect with the old-style blowgun by regulating its air pressure to 30 psi. But this will reduce the effectiveness of the air stream.

Tire inflator. The tire-inflator chuck is the cheapest of all air tools. If you have a compressor, you probably already have one. You can put air into anything that has a Schrader valve and some things that do not. With a basketball needle and pressure gauge, it enables you to pressurize tires, balls, and air mattresses (use care to avoid rupture). Air chucks are available in plastic or brass, long or short.

The list of air tools on these pages will give you ideas of what other air tools are available.

Air-tool accessories

A host of accessories is available to make your air tools more useful. Some, you'll find, are more necessities than accessories.

Quick connectors. A set of quick couplers is a must for air-tool efficiency. It consists of one female master cou-

[Continued on page 122]

Cooling-system service

for today's hotter-running engines

Neglecting the cooling system can take years and miles off an engine's life

By **RAY HILL**

DRAWINGS BY RAY PIOCH

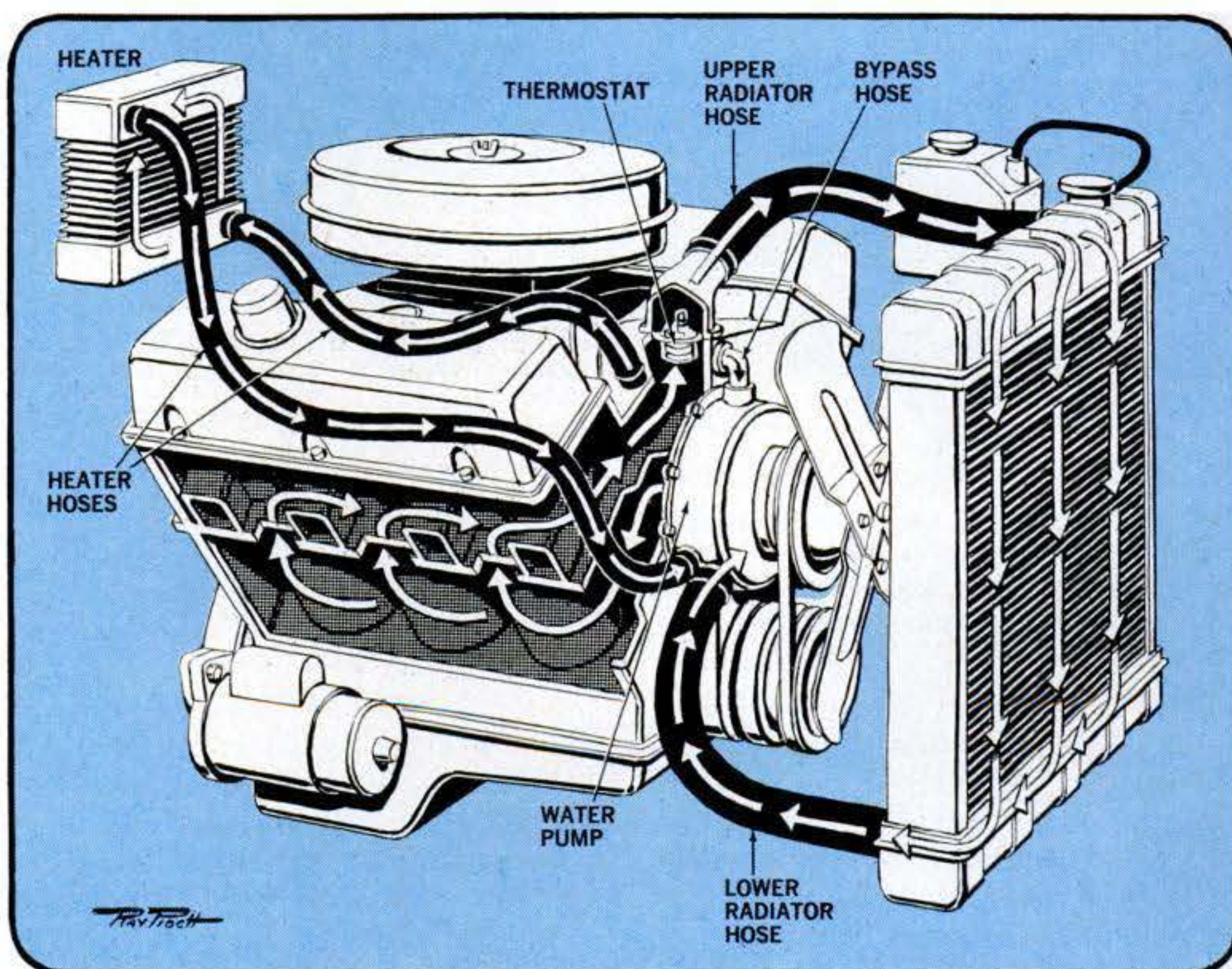
A cooling system that doesn't maintain the proper temperature can hurt your car's engine. If the coolant is too cold, moisture that normally collects in the oil may not evaporate. Crank-case deposits can build up, and engine life may be shortened. Too hot, and the oil can thin out, causing parts to wear faster.

Old parts can create headaches, too. An overage radiator hose might rupture, spilling out precious coolant. Or a worn-out water-pump belt could break, causing the engine to overheat. The law of averages being what it is, chances are that a breakdown will happen miles away from home, leaving you stranded.

Servicing the cooling system regularly can prevent these problems. Once every two years the cooling system should be drained and flushed. New hoses should be installed. The thermostat and pressure cap should be checked or replaced, and fresh coolant should be added. Here's how to do it properly.

The first step, ideally, is to pressure-test the cooling system. If, however, a pressure tester isn't handy, you haven't had to add excessive amounts of coolant at the recovery reservoir, and a visual inspection shows no leaks, then it's probably safe to assume that the cooling system is able to maintain its rated operating temperature and pressure and just needs normal servicing.

Remove the radiator cap—when the



In a typical cooling system, water pump draws coolant from lower radiator tank, forcing it through engine. Bypass hose allows coolant to circulate within the engine before the thermostat opens. This prevents hot spots and aids in quicker warmup. When the thermostat opens, hot coolant flows to top of radiator, down

through radiator core (where much of its heat is lost), and back into engine. Radiator shown above is the down-flow type. Others use a cross-flow design—a tank is mounted on either side of core. Coolant enters at the top of one tank, flows across the radiator core to the tank at the other side, and back into the engine.

engine is cold—and check for the presence of engine oil or transmission fluid in the coolant.

Transmission fluid is readily noticeable as a red oil floating on top of the coolant. It is caused by a leaking transmission cooler, which is located in the bottom of the radiator. Engine oil will give the coolant a brownish color and an oily consistency. A cracked head or block or a bad head gasket are likely culprits. If either oil is present, the cause of the leakage

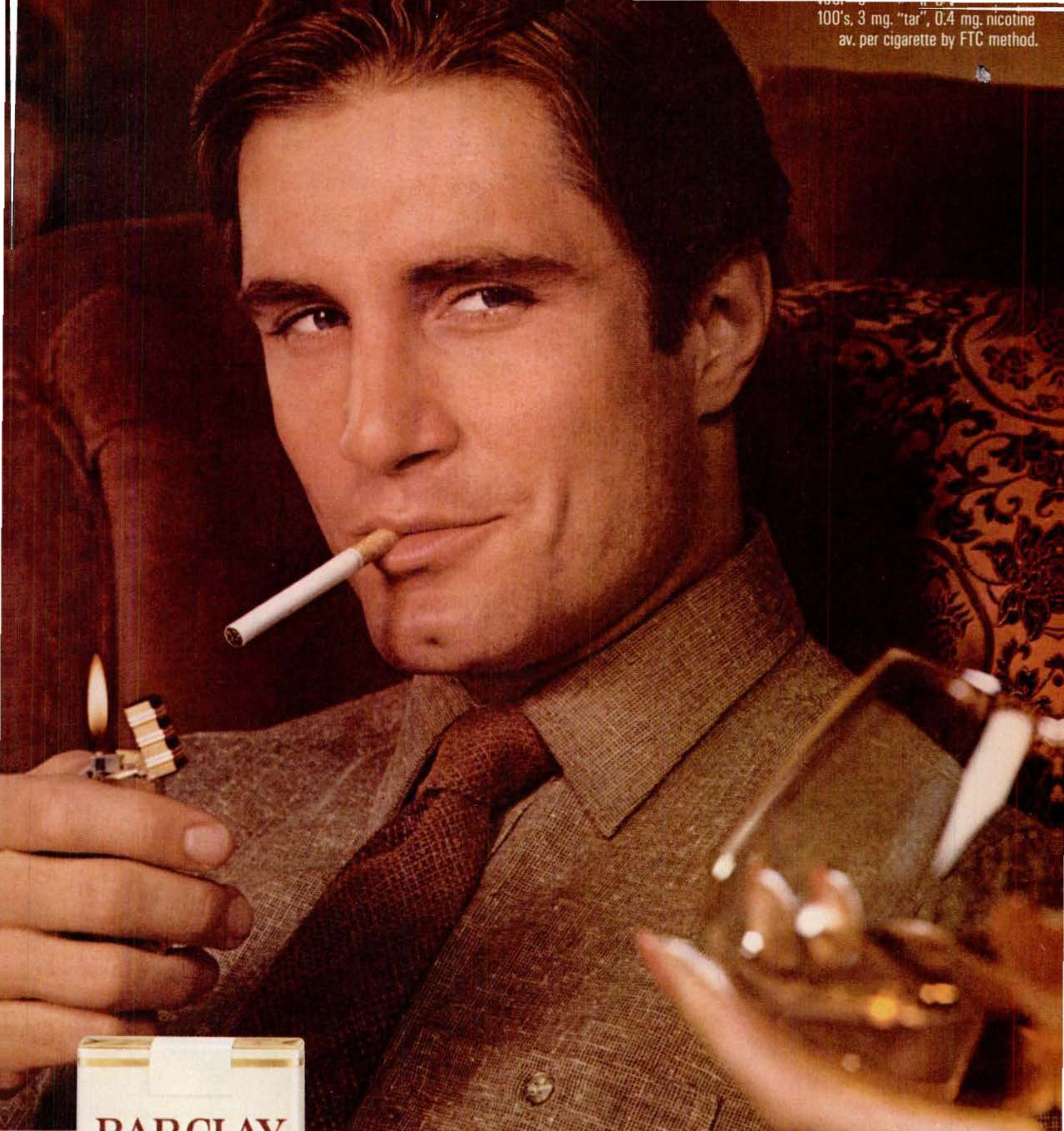
must be found and eliminated before proceeding.

If the coolant is free of transmission fluid and engine oil, add a cooling-system flush such as Prestone 10-Minute Radiator Flush. This helps break loose corrosion and other unwanted materials so they can be flushed out.

Follow the instructions on the can. With this particular flush you pour the contents in the radiator, run the engine at fast idle for 10 minutes after

Continued

100's, 3 mg. "tar", 0.4 mg. nicotine
av. per cigarette by FTC method.



99% tar free.TM

Also available in 100's and Box

The pleasure is back.

BARCLAY

Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health.

STOP STALLING. PUT IN AUTOLITE, THE WIDE-HEAT-RANGE PLUG.

If, some mornings, your car refuses to leave the driveway, or hates saying goodbye to stop signs, you may well be the victim of something called "cold plugs."

Poor starting, misfiring, and hesitating are often caused by oil and carbon deposits on the spark plug tips.

To burn these off, you need what are called *hot* plugs.

But, for effortless high-speed running on the highway, you're better off with *cold* plugs. (That's what race cars use.)

So what should you put in your car?

Try putting in, not just new plugs, but a new *brand* of plugs.

Autolite spark plugs. With Power Tips.*

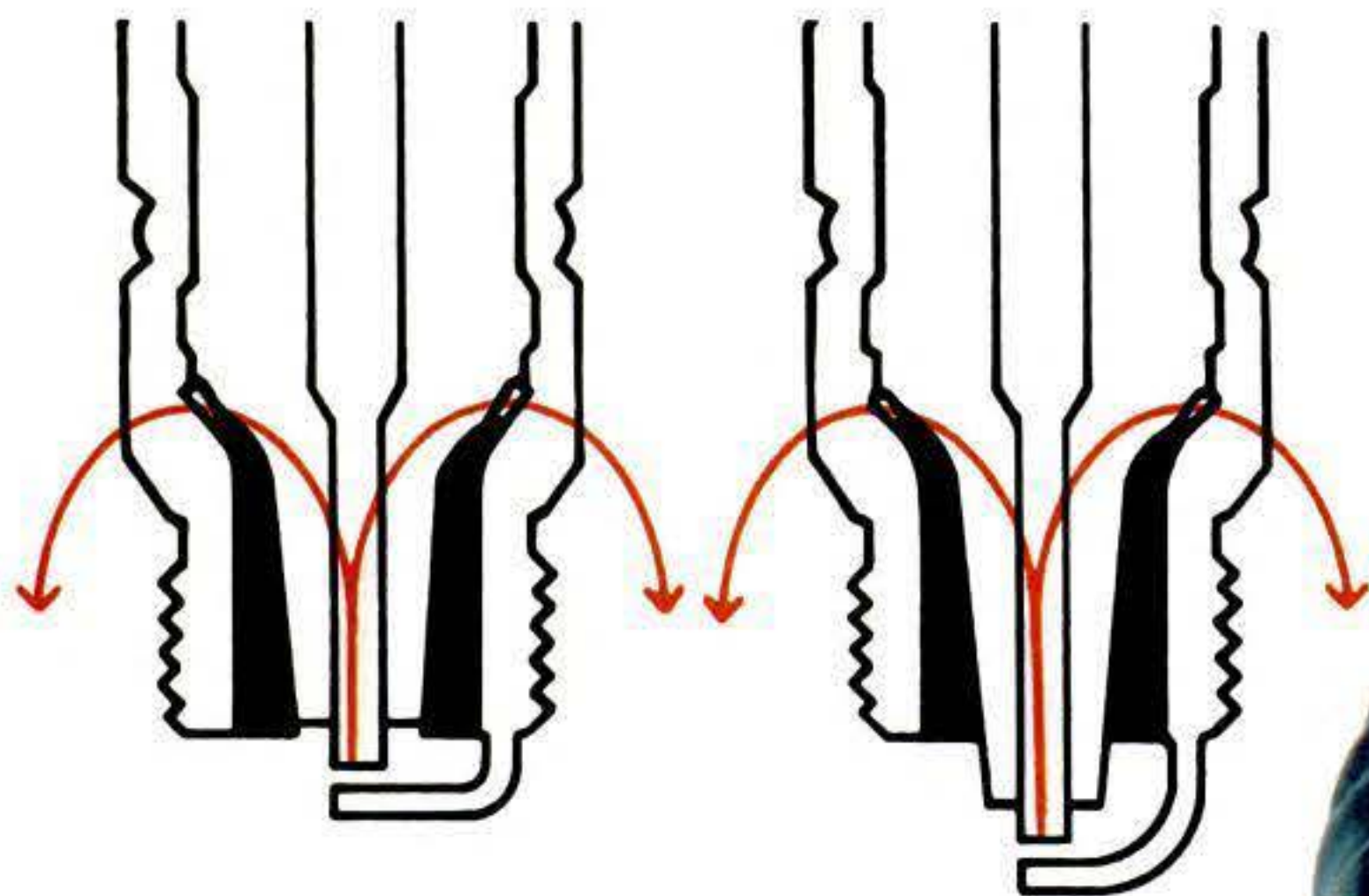
The Power-Tip Autolite is a remarkable plug. It has what mechanics call a *wide heat range*.

Because of its wide-heat-range design it works like two plugs—a hot plug *and* a cold plug.

It runs hot on short trips, to burn off carbon, and cold on long trips, for smooth driving.

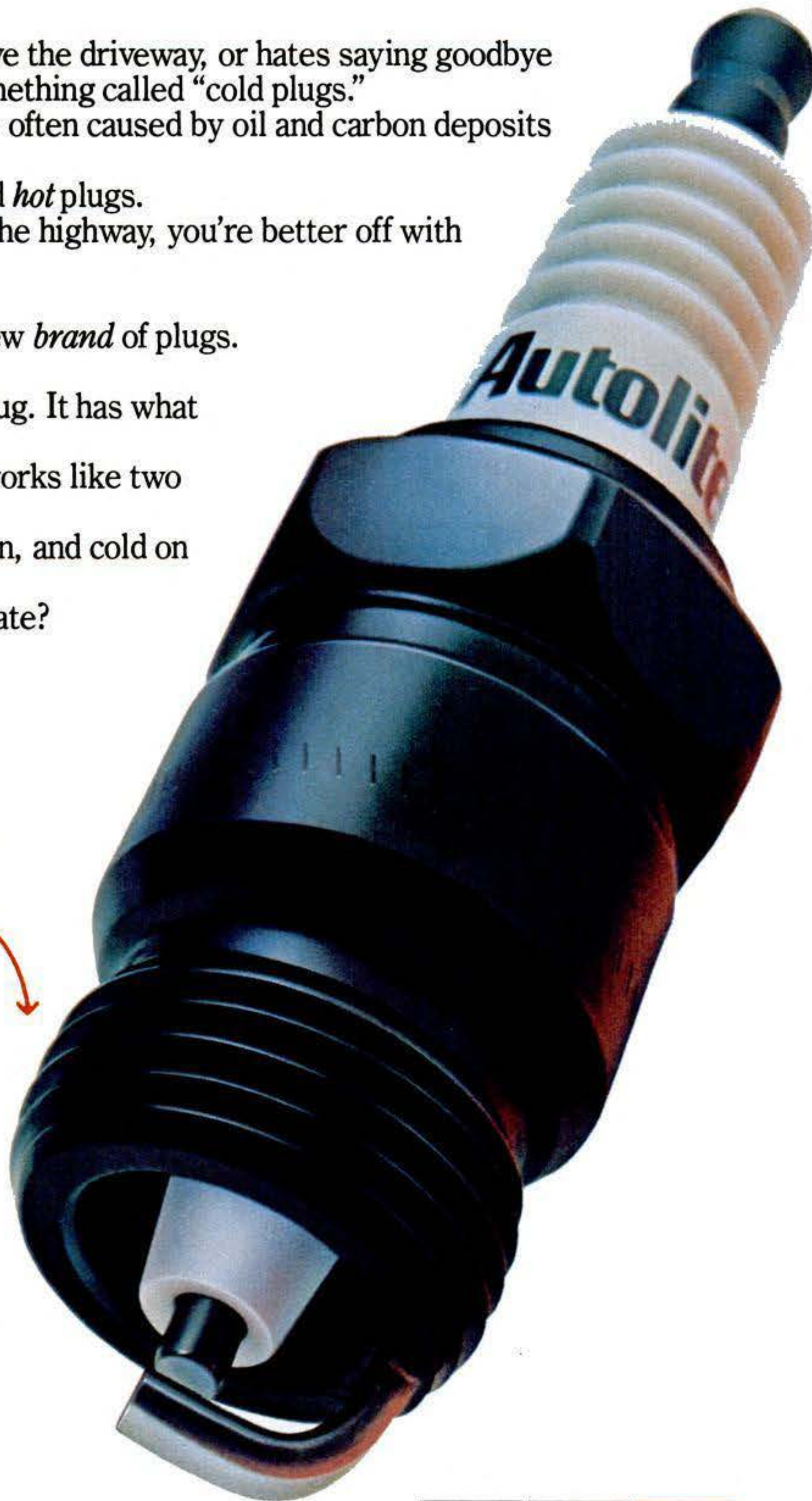
So if your car stalls or misfires, why hesitate?

Put in Autolites.



In an ordinary plug, the tip is short, which makes it lose heat faster at low speeds. And, because it's not as exposed to cool intake gasses, it stays hotter at high speeds.

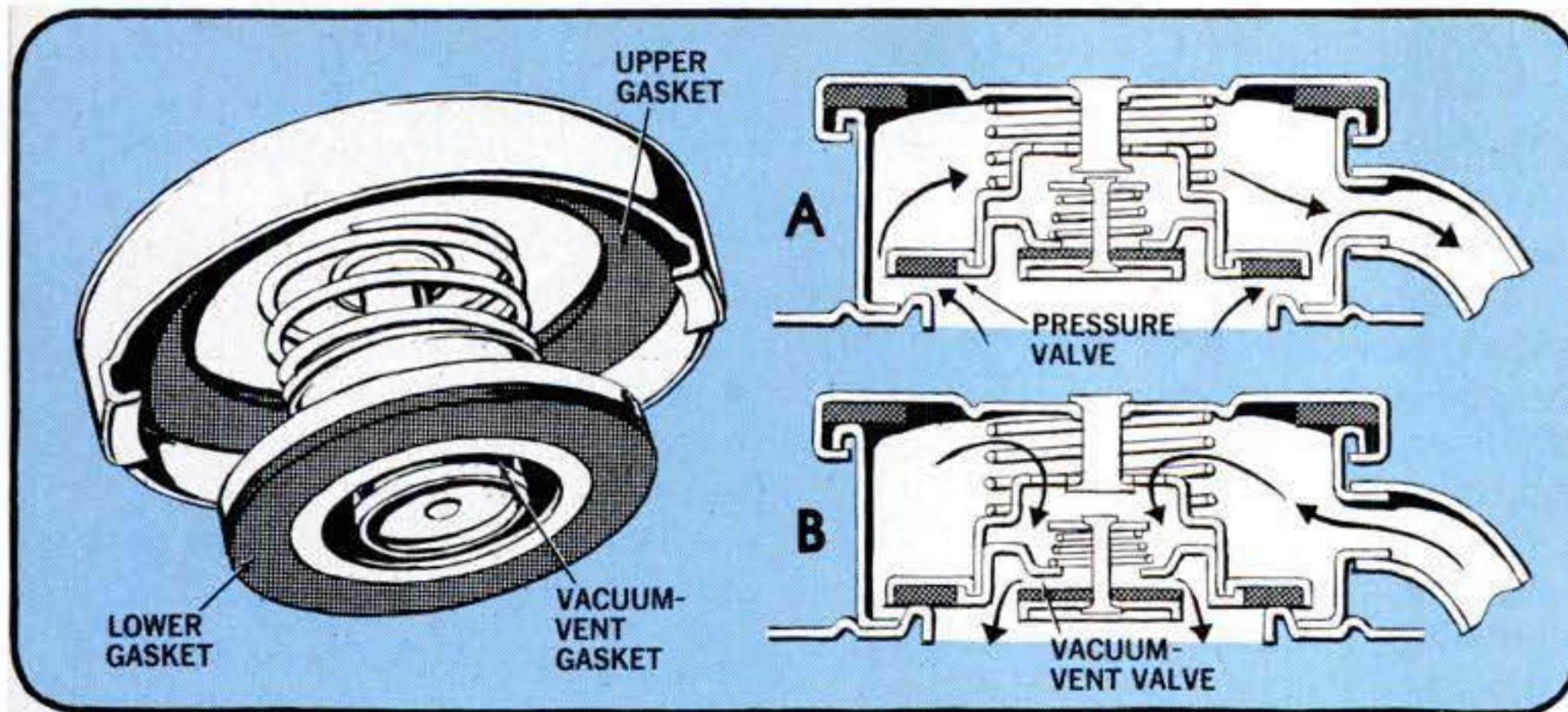
Autolite Power Tip plugs have longer insulators and electrodes. Heat transfers more slowly at low speeds, so carbon burns off. But at high speeds, low-temperature intake gasses keep the tip cooler, to help prevent pre-ignition and overheating.



*Available for cars where space in the combustion chamber is sufficient to accommodate the Power Tip.



Fram and Autolite are Bendix Companies
Fram Corporation, Providence, Rhode Island 02916



Radiator pressure cap has three important sealing gaskets—upper, lower, and vacuum-vent. All must be in good shape, as must be the pressure-relief and vacuum-vent valve springs. When the engine gets hot, coolant and air in the system expand, causing a pressure buildup. The pressure valve in the radiator cap opens (A), and coolant and air flow out through the cap

into the coolant-recovery reservoir. When the engine is shut off, it cools. The coolant and air inside the system contract, creating a vacuum. This pulls open the vacuum-vent valve (B), and coolant and air from the recovery reservoir rush in to fill the void. This prevents damage, which would otherwise occur because of the vacuum, to the hoses and radiator.

it reaches operating temperature, shut the engine off, and drain the system while it's still hot. (Leave the radiator pressure cap off after adding the flush. This way you don't have to worry about burning yourself by removing the cap from a hot, pressurized system.)

Draining the coolant

The radiator drain cock is at the bottom of the radiator, usually facing the engine (although sometimes it may be on the bottom of the radiator tank, facing the ground). Turn the drain cock counterclockwise to loosen it. Let all the radiator coolant drain into a container.

The block may have one or two drain plugs. An in-line engine normally has one plug; a V-type has two, one on each side of the block. Your service manual should show where each plug is located.

With some engines, especially those that have not had the block drained in a long time, you may find that nothing comes out when you remove the plug. Corrosion is blocking the hole; stick a screwdriver into the hole to break the corrosion loose.

Flush the engine with water: With the radiator drain cock still open and the block drain plug out, fill the radiator with water from a garden hose. Have a friend start the engine.

Soon the water level will drop sharply in the radiator (when the thermostat opens and water is forced into the block). Be ready with your hose. Add water until the radiator is again full. Adjust the water flow from

the hose so that the radiator stays full while the engine idles. Remember, water is flowing out the bottom of the block and radiator, so water must be constantly added.

Let the engine run until the water coming out the bottom of the radiator is clear. Then let the engine and water run five more minutes. Shut the engine off, turn the water off, and let all the water drain out of the radiator and engine.

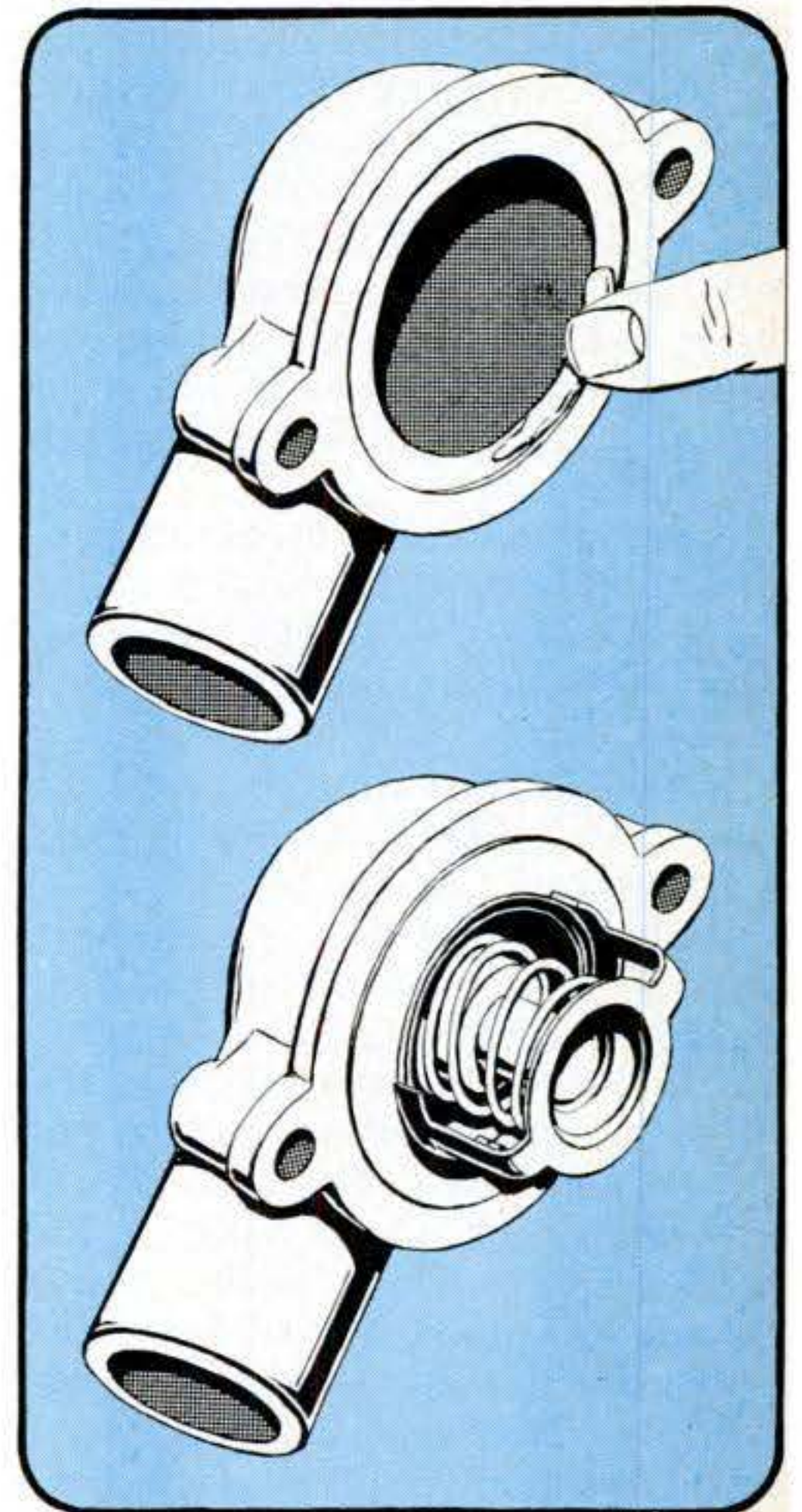
Tighten the radiator drain cock. Reinstall the block drain plug, and tighten it with a wrench. It has a tapered pipe thread and does not screw in all the way, so don't be alarmed that some threads are still showing.

Replacing hoses

Radiator hoses, heater hoses, and the coolant-bypass hose (if your car has one) should be replaced next.

Radiator hoses. The radiator has an upper and lower hose. The lower hose connects the radiator to the water pump, which forces water through the engine block and back to the radiator. The upper hose connects the radiator to the thermostat, which determines the rate of coolant flow from the engine through the radiator.

Remove the hose clamps. If a clamp is difficult to remove after it has been loosened, don't try to stick a screwdriver between it and the hose to pry it off. You can damage the brass radiator connection. Cut off the clamp with diagonal cutters. If the clamp is of the spring-type variety, use spring-clamp pliers (which are available at auto-



Side-mounted thermostat housing should have gasket sealer placed around the lip inside the housing against which the thermostat fits. This will hold the thermostat in place during installation; without it, you could damage the housing.

parts supply stores) to remove it.

Remove the hoses. If a hose doesn't easily pull off its connection, don't exert a Herculean effort to yank it off. You may bang your elbow or possibly pull the top off the radiator. (I once saw a man do both at the same time.) Cut the hose off with a single-edge razor blade.

Remove any material from the upper- and lower-hose connections (at both the engine and radiator) with a gasket scraper and emery cloth.

Replace the lower radiator hose, first slipping the clamps over the hose. Use new clamps to replace any old ones that are in doubtful shape or that were damaged during removal.

Be sure the hose is completely seated at each connection, then tighten the clamps.

But before replacing the upper radiator hose you should install a new thermostat.

A thermostat is inexpensive. Replacing it every two years along with the hoses virtually eliminates the pos-

Continued

sibility of a malfunction occurring.

Use the correct-temperature thermostat. Don't try to second-guess the engineers that built your car. Your engine operates best at a certain temperature. Installing a hotter or colder thermostat can make the engine less efficient and can shorten its life. Your service manual will tell you which thermostat to use.

Some cars have a temperature-control switch on the thermostat housing. If yours is one of these, label and remove the vacuum lines (usually two or three).

Remove the two bolts that hold the housing on, and pull the housing and thermostat off the engine.

Scrape both gasket surfaces clean (the housing-gasket surface as well as the engine-gasket surface).

With thermostats that mount on the side of the engine instead of on top, put a little high-tack gasket sealer, such as Permatex 9A, on the flange in the housing against which the thermostat fits. Then place the thermostat against the flange (see accompanying drawings). The gasket sealer will hold the thermostat in position. If you don't do this, the thermostat may slip down between the housing and engine as you install the housing; then, when you tighten the mounting bolts, the housing will crack.

Put high-tack gasket sealer on the housing's gasket flange to hold the gasket in place. Place the gasket on the housing, and put gasket sealer on the side of the gasket that's still exposed.

Before placing the housing containing the thermostat against the engine, double-check to be sure you have the thermostat installed correctly. Many thermostats are marked so you know which side goes toward the radiator. If it's not marked, the biggest side (or largest half) goes toward the engine.

Put the thermostat housing in place. Install and tighten the two bolts that hold on the housing.

Install the upper radiator hose. Reattach any temperature-control-switch hoses that were removed.

Heater hoses. The same rules apply here as with radiator hoses. A couple of extra pointers:

Never attempt to pull a heater hose off the heater-core connection after removing or loosening the clamp. The small brass connection can easily be pulled out of the heater. Slit the hose with a single-edge razor blade and peel it off.

A heater hose will usually have an

inside diameter of $\frac{1}{2}$, $\frac{5}{8}$, or $\frac{3}{4}$ inch. Often the inside diameter is marked on the outside of the hose. If it's not, measure the old hose. The two heater hoses may or may not have the same inside diameter. Check both.

Stretch the old hose beside the new one, and cut the new hose to the exact length of the old one. A hose that's too long may chafe against something, eventually wearing a hole in it. One that's too short may be difficult or impossible to install or may bend too sharply at its connections.

Bypass hose. Most engines have a bypass system. This lets coolant circulate in the engine (but not through the radiator) to prevent overheating while the thermostat is still closed. With some cars the coolant circulates through an internal passage in the engine. With others, part of the passage is through an external hose—the bypass hose.

Check your service manual to see if your car has a bypass hose and, if so, where it is located. (If your car happens to be one of the few that has a coolant-controlled automatic choke, this hose should be replaced now.)

Adding fresh coolant

While some service stations may recommend a water-antifreeze mixture based on giving you protection to the lowest temperature expected in your area, car manufacturers say that's not the best way to do it. They all recommend a 50/50 mixture of antifreeze and water to refill the cooling system. This provides both optimum cooling and freezing protection. Check your car's service manual for the cooling-system capacity. Cars usually hold somewhere between eight and 21 quarts.

Add the antifreeze first. This would amount to half the total capacity of the cooling system. Then finish filling with water. Here's the drill:

- Fill the radiator.
- Start the engine. When the fluid level in the radiator drops, fill until the level is within a few inches of the bottom of the fill neck.

● Add a cooling-system sealer. This helps prevent tiny leaks. The engine should be at operating temperature when the sealer is added so the sealer will spread throughout the system.

● Add a water-pump lube and conditioner, such as Du Pont's Cooling System Anti-Rust & Water Pump Lubricant. This helps fight corrosion, neutralize acids, and keep the water-pump seal from hardening.

● Top off the radiator with water. The fluid level should be about an inch from the bottom of the filler neck.

- Shut the engine off.
- Install the radiator cap. If you did not pressure-test the old one, it's a good idea to put on a new cap.

● Add fluid to the coolant recovery tank if it is low. Use a 50/50 mix of antifreeze and water, and use the same mix in the future when fluid is needed.

Replacing belts

Your engine will have one or more belts. To get the proper replacements, tell your parts supplier the year, make, model, and engine size of your car and how many accessories it has.

Here are some tips on replacing belts:

The alternator, power-steering pump, and A/C pump are often used as belt tensioners. Usually these components have a main mounting bolt and one or two bolts that lock the unit in place to apply tension. The A/C belt usually has an idler pulley that supplies tension.

Find the device that applies belt tension, loosen it, and pull up on the belt with your hand. This should cause the tensioning device to pivot, allowing slack in the belt so it can be removed. If you can't get enough slack this way, use a pry bar to move the component.

When installing the new belt, use a pry bar to apply tension to the tensioning device. The best way to adjust the belt is with a belt-tension gauge. Gates sells a good one (for around \$13) that's useful for the do-it-yourselfer.

Your car's shop manual will probably give a spec for adjusting the belt with a gauge. If no gauge is available, tighten the new belt so it has no more than $\frac{1}{2}$ inch of up-and-down movement when you grasp it midway between any two pulleys.

After the engine has been run a couple of days, recheck belt tension. If you tightened the belt without using a gauge, it will almost surely have loosened. This second retensioning should take care of it for good, now that it's broken in.

If your service manual provides a new-belt tension spec and you used a gauge to tighten the belt, this spec allows for the initial stretching of the new belt. It should not be necessary to retension the belt.

Regardless of which method you use to tighten new belts, check belt tension and condition periodically. **E**

Take 6 exceptional books for \$ 2⁹⁵

(values to \$120.65)

1160
List \$12.95
ELECTRICAL WIRING HANDBOOK
BY EDWARD L. SAFFORD JR.

1245
List \$16.95
1001 THINGS TO DO WITH YOUR PERSONAL COMPUTER
BY MARK...

1261
List \$12.95
SECRETS OF 123 OLD-TIME SCIENCE TRICKS & EXPERIMENTS
123 tricks, games, puzzles, and experiments to make science fun for the whole family!

1015
List \$10.95
A BEGINNER'S GUIDE TO COMPUTERS & MICROPROCESSORS
with projects

1265
List \$18.95
GIANT HANDBOOK OF 222 WEEKEND ELECTRONICS PROJECTS
Hands-on, how-to-do-it guide to all kinds of fascinating electronic projects!

1015
List \$31.90 (2 vol. in 1)
30 PROJECTS TO IMPROVE YOUR STEREO SYSTEM
BY DAVID B. WEEMS

905
List \$9.95
BUILD-IT BOOK OF DIGITAL ELECTRONIC TIMEPIECES
BY ROBERT HAYLAND

1066
List \$19.95
THE ILLUSTRATED DICTIONARY OF ELECTRONICS

1128
List \$10.95
HOW TO MAKE HOME ELECTRICITY FROM WIND, WATER & SUNSHINE
A complete guide to using nature's forces to make your own electricity.

805
List \$12.95
99 TEST EQUIPMENT PROJECTS YOU CAN BUILD
A step-by-step guide to building all kinds of practical electronic test equipment.

1113
List \$9.95
Understanding Electronics
All an electronics circuit—what it does, what the components do, what they do, and how to use them.

1020
List \$9.95
AUTOMOTIVE AIR CONDITIONING HANDBOOK—INSTALLATION, MAINTENANCE & REPAIR
A complete guide to automotive air conditioner installation, service and repair.

1060
List \$9.95
303 DYNAMIC ELECTRONIC CIRCUITS
A rich source of extremely usable, ready-to-build circuit designs for technicians, hobbyists, and engineers.

1248
List \$14.95
44 Electronics Projects for the Darkroom
A do-it-yourselfer's guide to making electronic projects.

1108
List \$11.95
LASERS, THE LIGHT FANTASTIC
A complete course in modern laser technology!

1055
List \$8.95
The BASIC Cookbook
A complete dictionary of all BASIC statements, commands, and functions—with programming examples and flow charts.

2062
List \$12.95
HOW TO MAKE YOUR OLD CAR RUN LIKE NEW
A step-by-step fix-it-yourself guide!

1006
List \$11.95
BUILD-IT BOOK OF SOLAR HEATING PROJECTS
A do-it-yourselfer's guide to planning, designing, building, and installing a solar heating system.

1056
List \$10.95
HOW TO INSTALL EVERYTHING ELECTRONIC IN CARS, BOATS, PLANES, TRUCKS & RV'S
A complete guide to buying, installing, and operating electronic equipment in all types of vehicles, including boats, RV's, airplanes, boats, cars, trucks, and more.

1062
List \$12.95
THE A TO Z BOOK OF COMPUTER GAMES
26 of the most popular computer games—how to play them, how to make them, and how to improve them.

2074
List \$9.95
HOW TO MAKE YOUR OWN ALCOHOL FUELS
How to build your own alcohol-powered engine, and how to use it to power your car or truck for less cost.

More fine books to pick from...

- **Artificial Intelligence.** List \$12.95. No. 1076
- **Master Handbook of Electronic Tables & Formulas—3rd Ed.** List \$15.95. No. 1225
- **The Complete Four-Wheel-Drive Manual—Converting, Collecting, Restoring & Repairing.** List \$12.95. No. 2055
- **The Complete Handbook of Magnetic Recording.** List \$16.95. No. 1059
- **How To Buy and Fly R/C Aircraft.** List \$14.95. No. 1221
- **Fiberoptics.** List \$14.95. No. 1236
- **How to Repair Briggs & Stratton Engines.** List \$8.95. No. 1087
- **Radio Astronomy for the Amateur.** List \$8.95. No. 714

7 very good reasons to try Electronics Book Club...

- **Reduced Member Prices.** Save up to 75% on books sure to increase your know-how
- **Satisfaction Guaranteed.** All books returnable within 10 days without obligation
- **Club News Bulletins.** All about current selections—mains, alternates, extras—plus bonus offers. Comes 14 times a year with dozens of up-to-the-minute titles you can pick from
- **"Automatic Order."** Do nothing, and the Main selection will be shipped to you automatically! But... if you want an Alternate selection—or no books at all—we'll follow the instructions you give on the reply form provided with every News Bulletin
- **Continuing Benefits.** Get a Dividend Certificate with every book purchased after fulfilling Membership obligation, and qualify for discounts on many other volumes
- **Bonus Specials.** Take advantage of sales, events, and added-value promotions
- **Exceptional Quality.** All books are first-rate publisher's editions, filled with useful, up-to-the-minute info



ELECTRONICS BOOK CLUB Blue Ridge Summit, PA 17214

Please accept my Membership in Electronics Book Club and send the 6 volumes circled below. I understand the cost of the books selected is \$2.95 (plus shipping/handling). If not satisfied, I may return the books within ten days without obligation and have my Membership cancelled. I agree to purchase 4 or more books at reduced Club prices during the next 12 months, and may resign any time thereafter.

714 805 905 1006 1015 1020 1055
1056 1059 1060 1062 1066 1076 1087 1097
1108 1113 1128 1160 1221 1225 1236
1245 1248 1261 1265 2055 2062 2074 8434

Name _____ Phone _____

Address _____

City _____

State _____ Zip _____

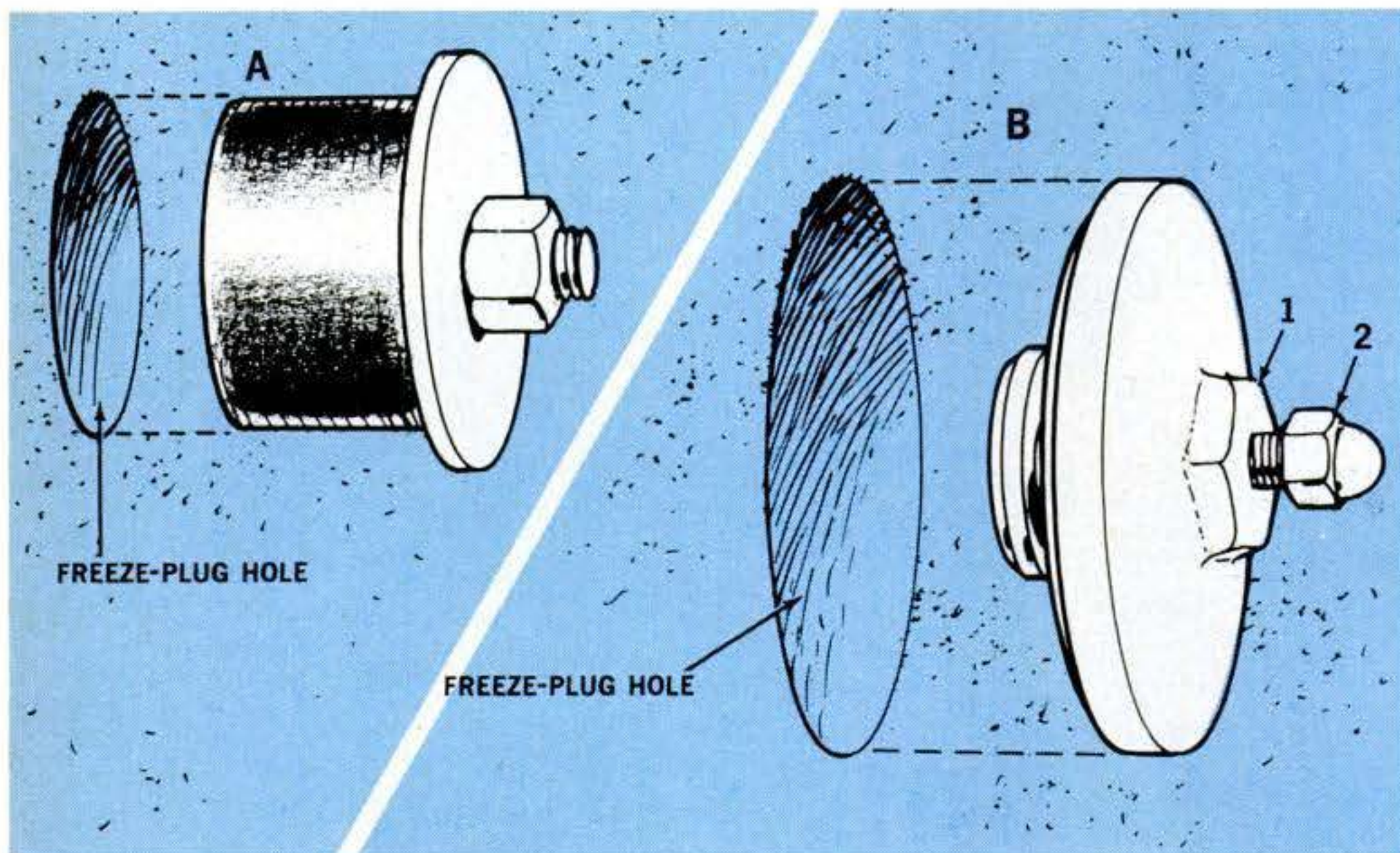
(Valid for new members only. Foreign and Canada add 20%.)

PS-681

TAKING CARE OF YOUR CAR

Got a useful car tip? Send it (with Social Security No.) to Car Care, Popular Science, 380 Madison Ave., New York, N.Y. 10017. We'll pay you \$25 if we use it. If two or more readers send in the same usable tip, the one with the earliest postmark will be chosen. Sorry, but tips can't be returned.

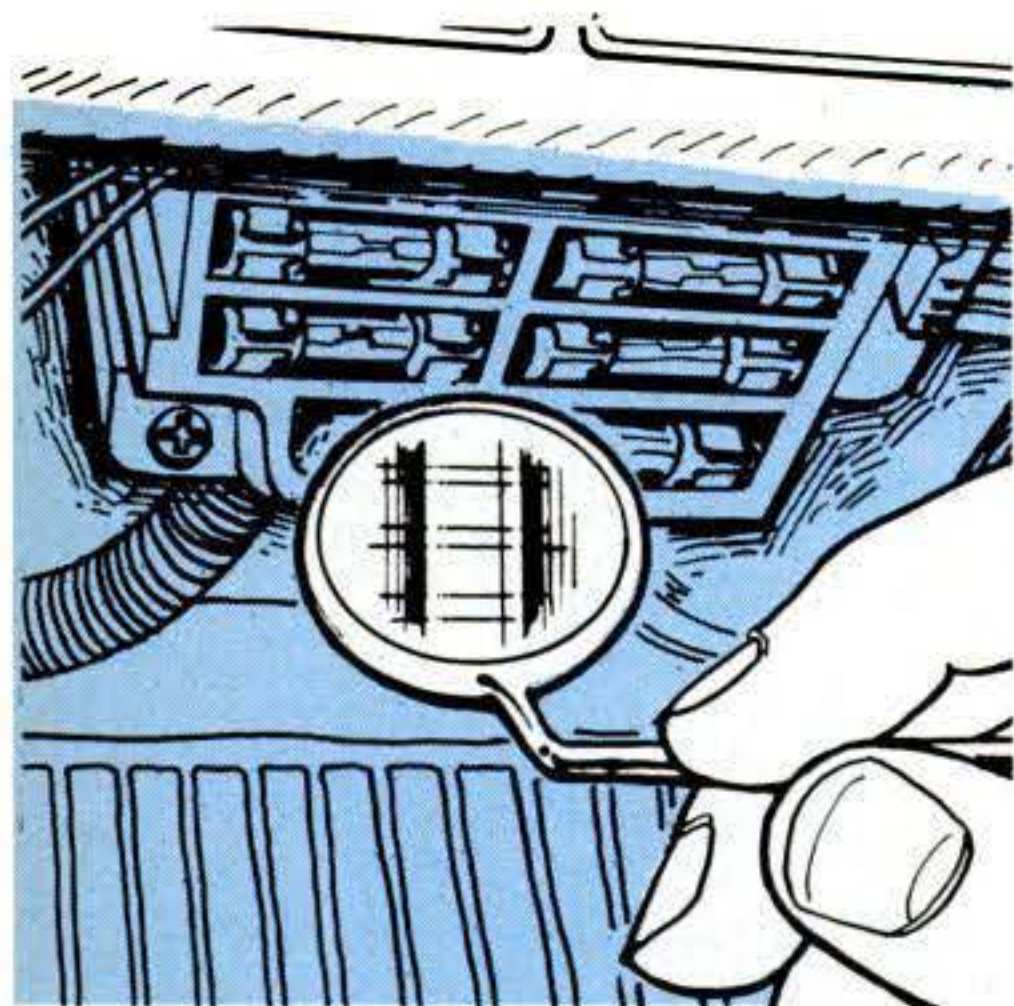
By RAY HILL



Replacing a leaking freeze-out plug with an expansion plug

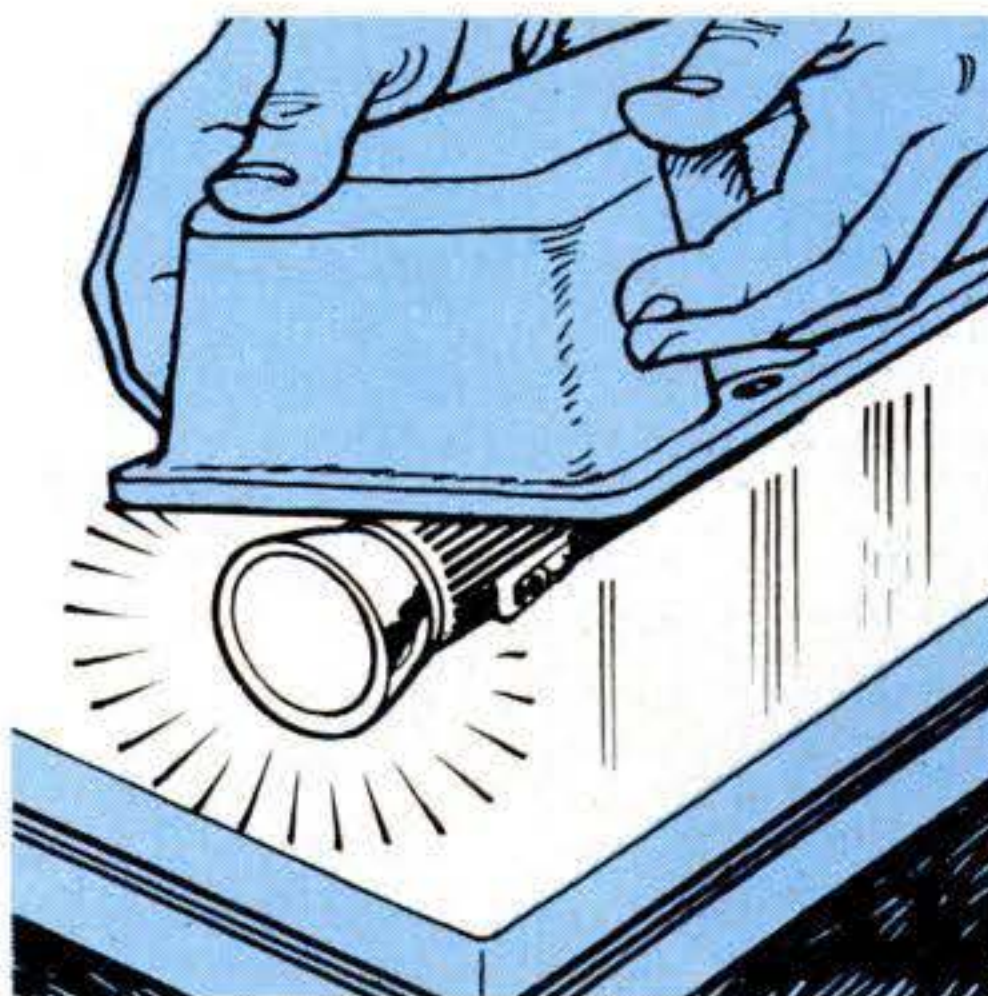
Corrosion sometimes causes a freeze-out plug to leak. Replacing it may be a problem because of its hard-to-get-at location. One solution: Instead of an ordinary freeze-out plug, use an expansion plug. There are two types of these plugs. One is a rubberlike plug (A). To use this type you must first remove the old freeze-out plug, then stick the replacement plug in the hole and tighten the nut. This expands the plug

tightly against the hole in the block, providing a good seal. The brass expansion plug (B) may not require removal of the bad plug. Insert it in the hole, hold the inner nut (1) to keep the plug from turning, and tighten the outer nut (2), which causes the plug to expand. There are many sizes of freeze-out plugs, so be sure your expansion plug is the same size as the leaking plug you are replacing.



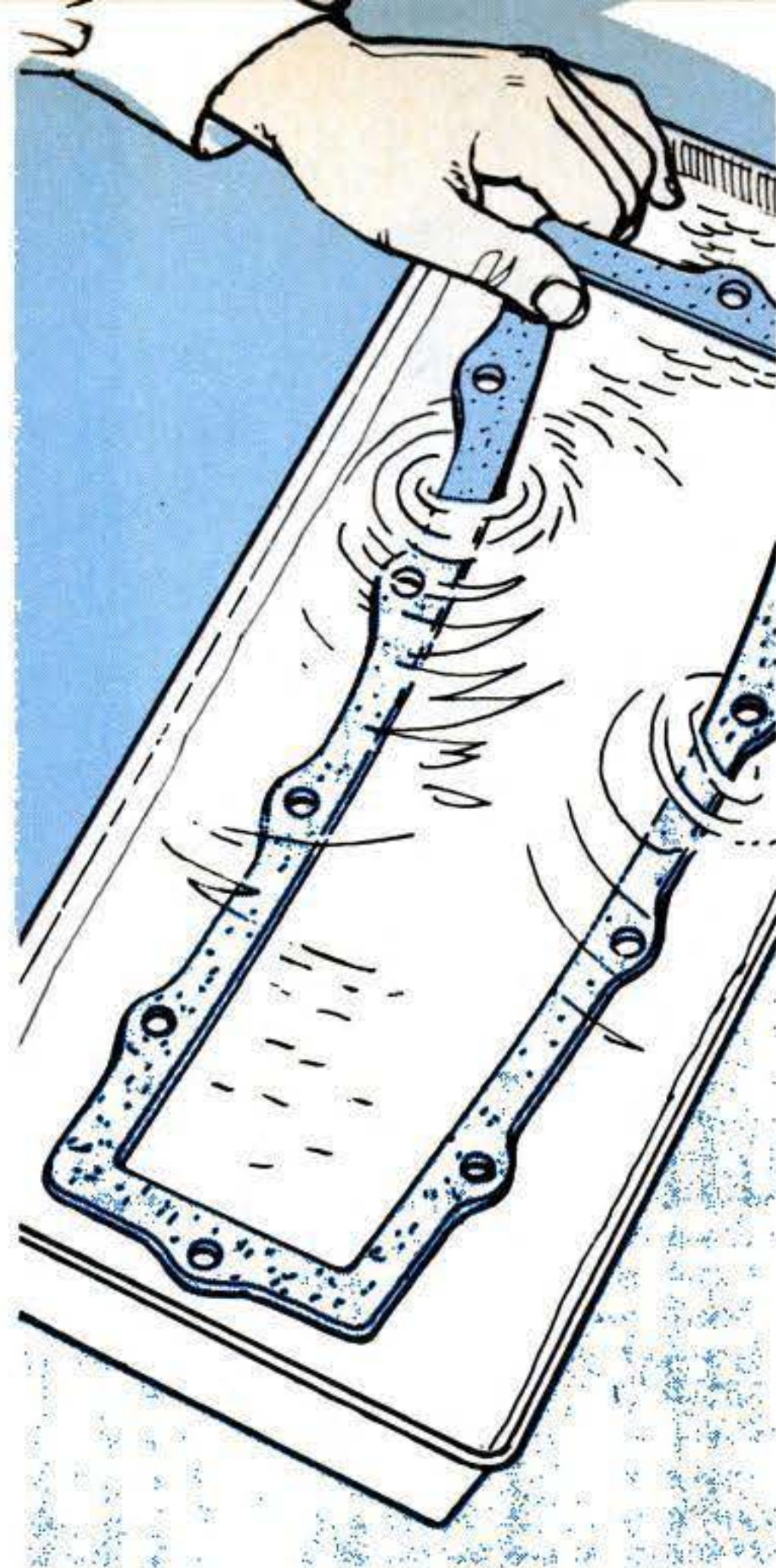
Under-the-dash prowling

Looking for a turn-signal flasher or another item under the dash? To avoid severe body contortions while searching, use a mirror (and a flashlight if needed) as shown. Sliding the seat back as far as it will go will give you maximum room in which to navigate. Never wear metal rings or wrist bands while working under the dash. They might hang up on something or accidentally touch electrical contacts, causing sparks and even burns.



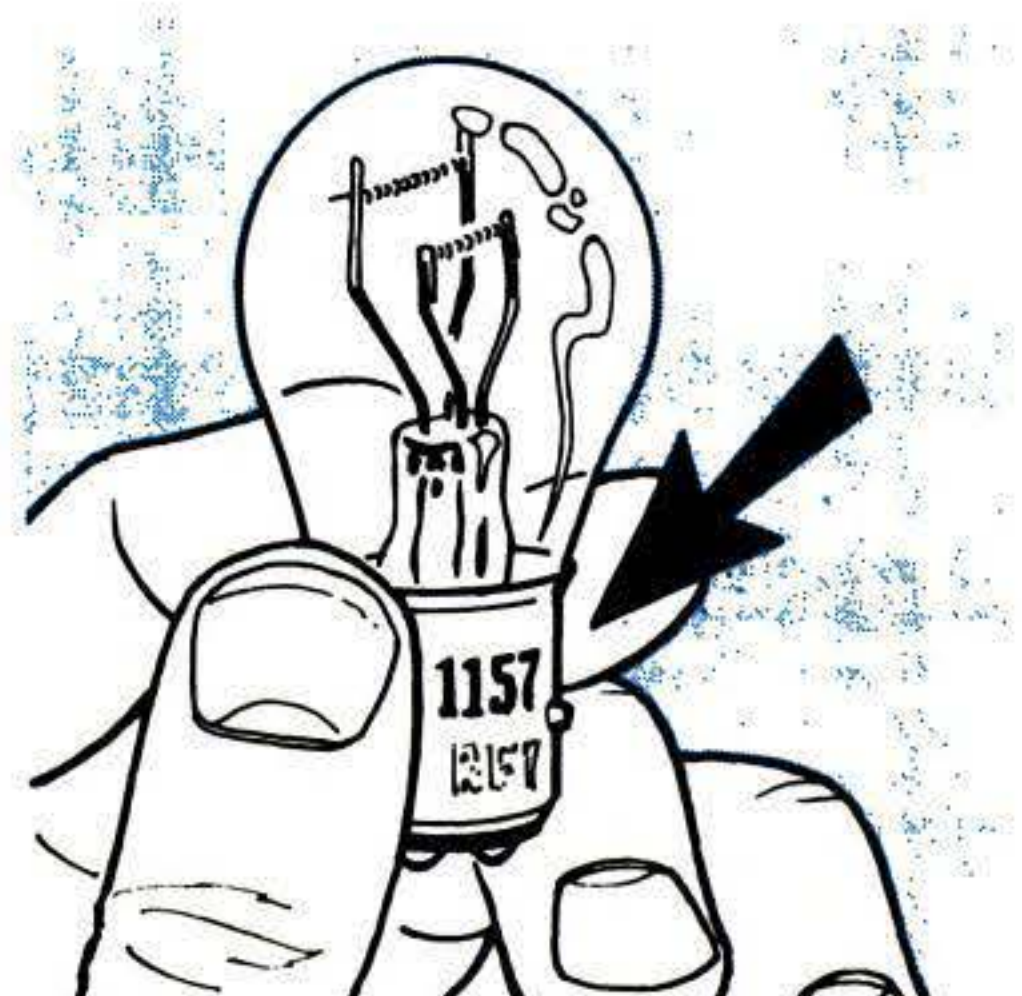
Checking a valve cover

A flashlight, flat surface, and a darkened room can help you find small cracks in a valve cover. Place the lighted flashlight on the flat surface, put the valve cover over the flashlight, and turn out the lights in the room. You'll now be able to see any tiny cracks in the valve cover—because the light from the flashlight will shine through. This is also useful for checking to see if the valve-cover gasket flange is perfectly flat (if it's not, flatten it).



Cork gaskets

Cork gaskets that are stored for a while can shrink or expand because of changes in humidity. This doesn't mean you have to throw the gasket away. If it has shrunk, immerse it in warm water until it expands to its normal size, then install it. If the stored gasket has expanded (not as common), place it in a warm oven to bake out excess moisture. Use gasket sealer on the valve cover to ensure a good seal.



Replacing bulbs

Installing the correct replacement for a burned-out bulb is important. Just because a new bulb looks similar doesn't make it right. A single-contact bulb in a double-contact socket, for example, can cause shorts or result in improper lighting. To get the correct replacement bulb, be sure that the part number at the base of the new bulb is the same as the one at the base of the OEM bulb. Make sure the socket is corrosion-free before installing.

FIRST TIME EVER! BEST EPA RATING EVER! AND CHEVY'S GOT IT! 20 MPG. V8 POWER.



Chevy V8 Special Economy Truck

BEST EPA ESTIMATED GAS MILEAGE RATING OF ANY V8 TRUCK EVER! EVEN BETTER THAN ANY V8 CAR, IMPORTED OR DOMESTIC!

Here are some surprising facts:

FACT: In the past 5 model years, over 80% of all domestic light-duty trucks were equipped with V8 engines!

FACT: In V8 power and economy, Chevy V8 Special Economy Truck beats its closest sales competitor's highest-mileage V8 by 3 miles per gallon and 47 horsepower!

FACT: Chevy V8 Special Economy Truck combines the power of a V8 with the economy of a Six!

FACT: Chevy Special Economy Truck has the best EPA estimated MPG of any V8 truck...even better than any V8 car, import or domestic!

FACT: Chevy Special Economy Truck is not only surprising—it's amazing!

28 EST.
HWY.

20 EPA
EST.
MPG
(CITY)

Use estimated MPG for comparisons. Your mileage may differ depending on speed, distance, weather. Mileage will be less in heavy city traffic. Actual highway mileage lower. Not available in California where com-

parisons do not apply.

Fuel economy comparisons exclude trucks with same powertrains offered by GMC Truck Division.

Chevy pickups are equipped with GM-built engines produced by various divisions. See your dealer for details.

See a limited production Chevy V8 Special Economy Truck today.



**BUILT TOUGH.
BUILT FOR ECONOMY.**

New Winston Ultra

Only
5 mg

The first
ultra low tar
built on taste.

Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health.



HOUSEPOWER CLINIC

By EVAN POWELL

How to stretch cool bucks

With energy costs constantly racing upward, it sometimes seems as though we have to choose between staying comfortable and staying solvent. A little attention to your air conditioner can help you do both.

First, turn off the power and clean away any debris that has accumulated near the outdoor coil. Clean the fan motor and oil it if oil ports are provided. On window units, be sure that water passageways that carry condensate from inside to outside are free of scale and algae.

Air flow is critical in air conditioning. Any shrubbery that has grown too close to the outdoor coil should be cleared away. Don't overdo this, however; shade can boost the cooling capacity. On the indoor side, clean the filters often during the summer. With a central system, be sure that air flows through the ducts properly. See that curtains and furnishings do not block return-air grilles. Adjust the supply-grille dampers to provide more air flow to large areas and those most distant from the blower. Less should go to small areas and unused rooms. Air deflectors installed over baseboard or floor registers can help direct the cold air upward to reduce stratification.

Too much humidity can make you feel warmer and reduce the air conditioner's cooling capacity, as well. A major source of moisture can be exposed earth beneath the house. Covering the ground with four-mil polyethylene (available from building-supply stores) will improve this condition.

Window air conditioners can be useful for spot cooling, even if you have a central system. You can install one to make a cool haven of one room and turn off the central system or raise the thermostat setting. If you do this, be sure to isolate the room as completely as possible. Stop infiltration of outside air around loose-fitting windows and doors with weatherstripping. Keep interior doors closed, and weatherstrip around them, too. Close registers in that room; they can be a major escape route for conditioned air.

Don't waste your money cooling the house when no one's home. Multiple-program thermostats allow you to set your cooling needs according to your daily schedule. If you're away from home regularly for longer than three hours, it pays to turn off your air-conditioning system or raise the thermostat setting. Also, you don't need as much cooling at night when you're asleep.

Combine thermostat setup programs with normal settings of 78-80 degrees

and you may be surprised how much energy you can save without sacrificing comfort.

Laundry economics

A recent study on the use of automatic washers and dryers, conducted by Oak Ridge National Laboratories for the Department of Energy, has produced some interesting results. The most surprising is that a cold-water wash cycle does save somewhat more energy than warm-water washing but is *not* more economical—the saving is surpassed by the cost of the extra detergent needed to get clothes clean. Warm water is much more economical than hot, however, and cleans most fabrics as well. And substituting a cold for a warm rinse saves about 11 percent of the total energy that is consumed in doing laundry.

Most large washing machines have a rated capacity of 18 pounds, but the average wash load is only about six pounds. Thus, the study suggests, a built-in laundry-weighing scale, integrated with an accurate water-level control, could achieve the most efficient use of heated water. (Westinghouse front-loading automatics had just such a scale—almost 30 years ago.)

Most dryers are also operated at only about one-third of rated capacity, the Oak Ridge study finds.

Saving laundry until larger loads can be done could result in significant energy savings.

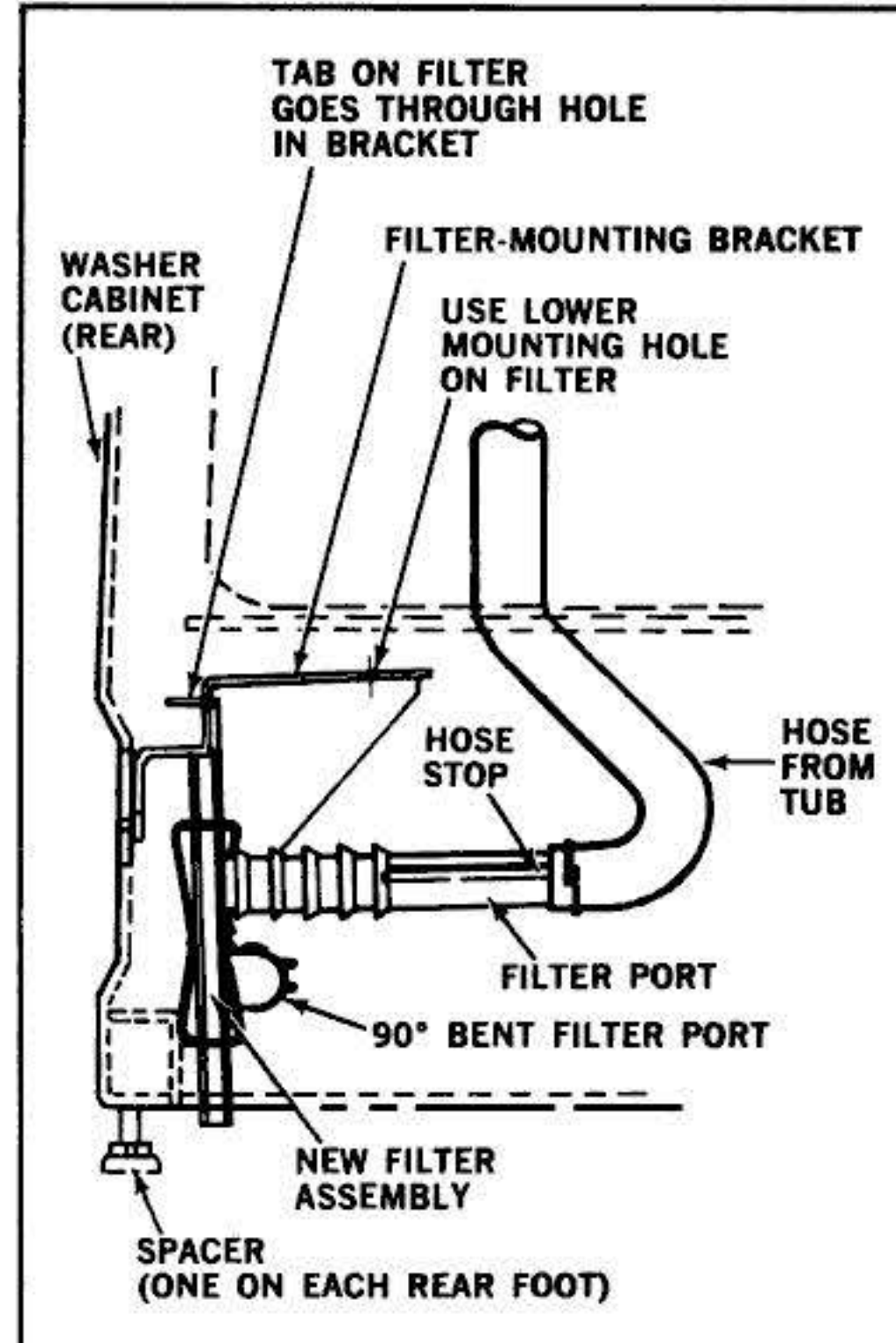
Q&A Filter change

About once a year the self-cleaning filter on my Sears 110.6904800 washer becomes completely clogged. I've replaced it three times because it was impossible to clear. Should I have to replace this filter every time it clogs?

Jack Thorne, Phoenix, Ariz.

A new self-cleaning, diaphragm-type filter has taken the place of the original "cone" filter on your washer. The new filter will seem to mount on its side (see illustration) and protrude slightly below the bottom of the cabinet. Follow replacement directions carefully, including those that specify adding a spacer to each of the two rear feet to prevent filter damage in case the feet are retracted.

The wash water from the tub circulates continually through the filter during the wash cycle. As the water is pumped out, the flow is reversed, which should flush out all the trapped material. The replace-



ment filter should be more reliable and will be substituted automatically when the original type is ordered.

That old flame—again

Your advice to "turn off the pilot" ["Housepower," Aug. '80] was misguided. Pilot lights are the greatest service-call preventive for any intermittent-use appliance. Granted, carbon dioxide and water may form carbonic acid, but not normally. Reason? The heat produced by the pilot keeps the appliance well above the dew point, even in a cool, damp cellar.

We make dozens of service calls to fix or replace rusted-out burners in gas appliances in which the pilot was shut off for "economy" or "conservation." Economy? Compare service charges plus replacement-burner cost with the cost of a little gas. Conservation? How far does your gas serviceman have to drive to take 50 milligrams of rust out of your pilot burner?

George Ballou, Ballou Gas Service

First, my reply about turning off the pilot was in answer to a question about a gas furnace with central air conditioning, which would run cooler than a furnace alone. However, your letter was among several similar ones I received, and they prompted me to poll manufacturers of gas-heating equipment again. Those I spoke with agreed with me that the pilot flame doesn't provide enough heat to keep the equipment and flue dry and is, in fact, the source of the moisture that causes the problem. They cite as proof the much lower frequency-of-service and replacement rates of heat exchangers in pilotless gas furnaces and in oil furnaces (which have no pilot).

Got a home-equipment problem? Write to Evan Powell/Housepower, Chestnut Mountain, Route 1, Box 322A, Travelers Rest, S.C. 29690, giving appliance make and model number. Unpublished questions cannot be answered by mail.

WORDLESS WORKSHOP

By ROY DOTY

\$50 to Ralph O. Fritts of Amsterdam, Mo., for this idea. Send yours (with Social Security No.) to Wordless, POPULAR SCIENCE, 380 Madison Ave., New York, N.Y. 10017. Only purchased ideas can be acknowledged.



HOW THE SUPER DOERS FINISH WHAT THEY START.



Stanley Surform[®] tools plane, shave, shape, file, smooth and finish what other tools start.

Super Doers of America[™] are doing more...and finishing what they do with Surform Tools. The blades have hundreds of razor sharp steel teeth to finish anything from wood and wallboard to formica and aluminum. Even cut end grain! Blades never clog, never gouge the work.

Fast, easy, safe to use, for every member of the family. Plus - new carbide grit sanding blades that outlast sandpaper.

Now the Surform Finish Line[™] has 23 tool-and-replaceable-blade combinations. Use one once; you'll never finish without them.

FREE! Carbide Sanding Blade when you buy a Surform Plane or File.

Look for this \$3.00 value on display in your store.



STANLEY
helps you do things right.[®]

© 1981, Stanley Tools, Division of the Stanley Works
Super Doers of America and Super Doers are trademarks of Stanley Tools.

Copyrighted material

Now you can kill wasps and hornets in their nests from...

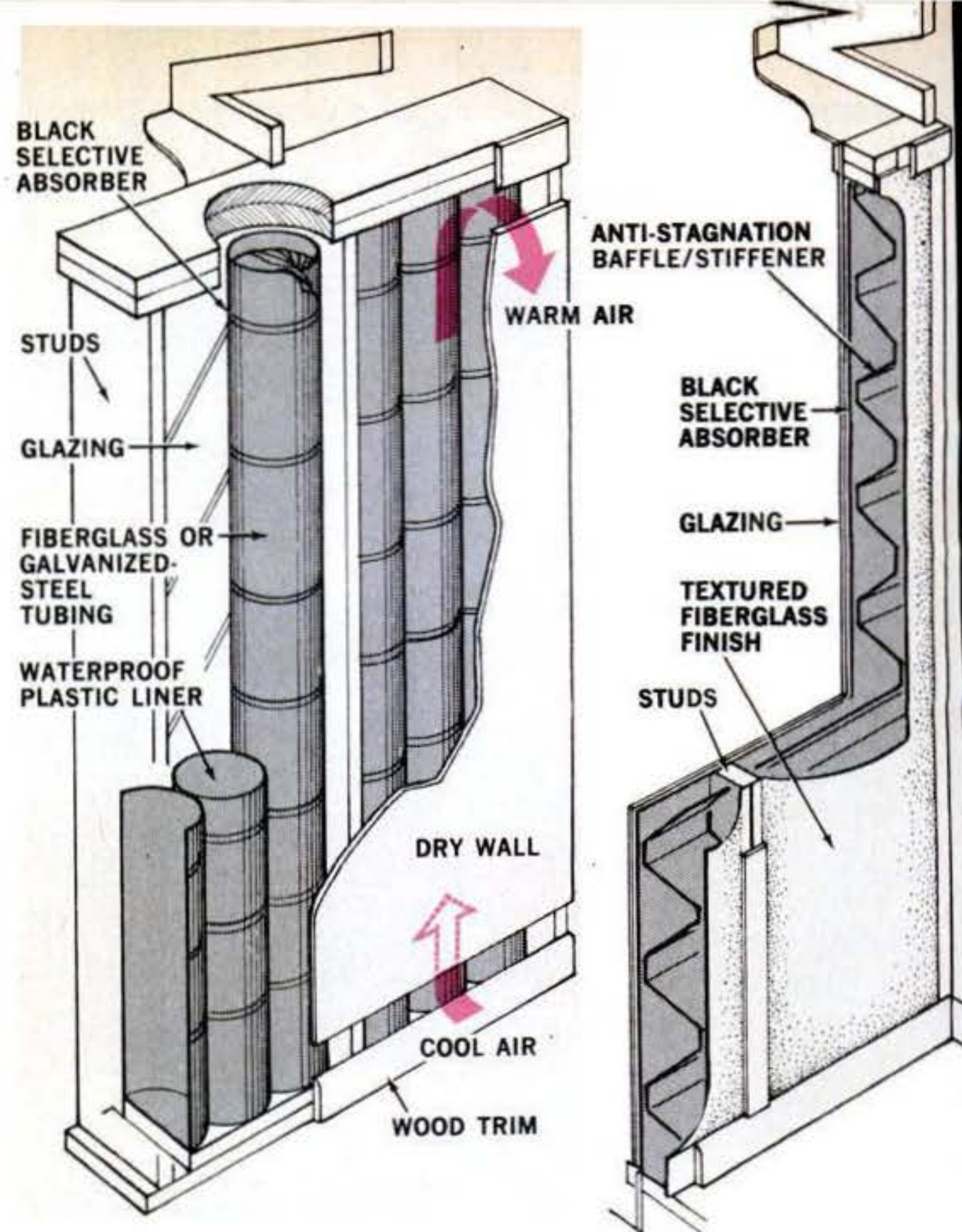
Tubes and tanks for solar heat storage

Water is the storage medium in two recently developed passive-solar heat-storage components. Developed under a grant from the Dept. of Energy, they're called Tubewall and Tankwall, and are what their names suggest.

Tubewall is made up of water-filled vertical fiberglass or metal tubes, generally set into a wall, although they can also be free-standing. In a wall, they're arranged side by side with no air gaps, to prevent thermal transfer around them. Clear glazing covers their exterior, with Sheetrock on the inside. Convection slots at the top and bottom of the Sheetrock allow cool air to flow up through the wall and be warmed before returning to the room.

A black chrome selective-absorption foil covers the sunny side of the tubes to enhance heat absorption. At night, it provides an R-12 insulating value.

Tankwall is composed of fiberglass water tanks with integral anti-stagnation baffles. The tanks mount between the studs of a solar-gathering wall. A companion unit fits a conventional patio door. The same selective-absorbing foil covers the sunny side, and only exterior glazing is required. A textured surface available in many colors forms the interior wall of your room. Because of this, Tankwall is said to be slightly more efficient, although an optional horizontal reflector is claimed to boost the efficiency of both by 45 percent. Tubewall and Tankwall are made by Waterwall Engineering, 8207 State Rd. 121, New Paris, Ohio.—*Ed Jacobs*



Two simple solar systems: Tubewall (left) indirectly heats room air via vents. Tankwall (right) has a fiberglass inner surface that directly transfers heat to room air by conduction.

...12 ft. away!

Raid Wasp & Hornet Killer has a long-distance spray-nozzle to keep you at a good distance. You spray it directly on the nest. It kills on contact and saturates the nest to kill late-coming or returning insects. Use it once and the job is done.



Raid

Johnson
Wax

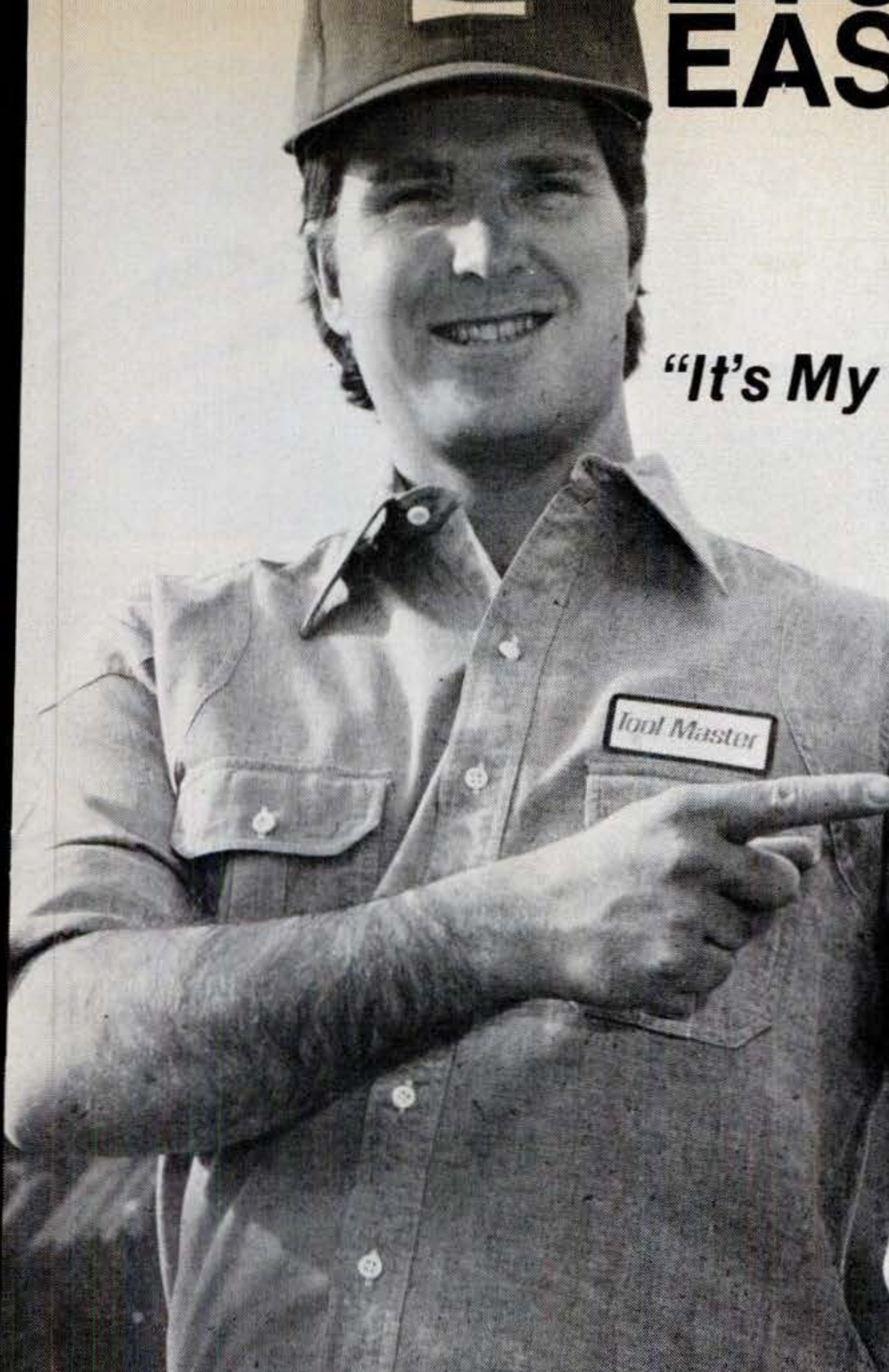
© 1978 S. C. Johnson & Son, Inc.

Copyrighted material

EASY TUGGER™

by *Tool Master*

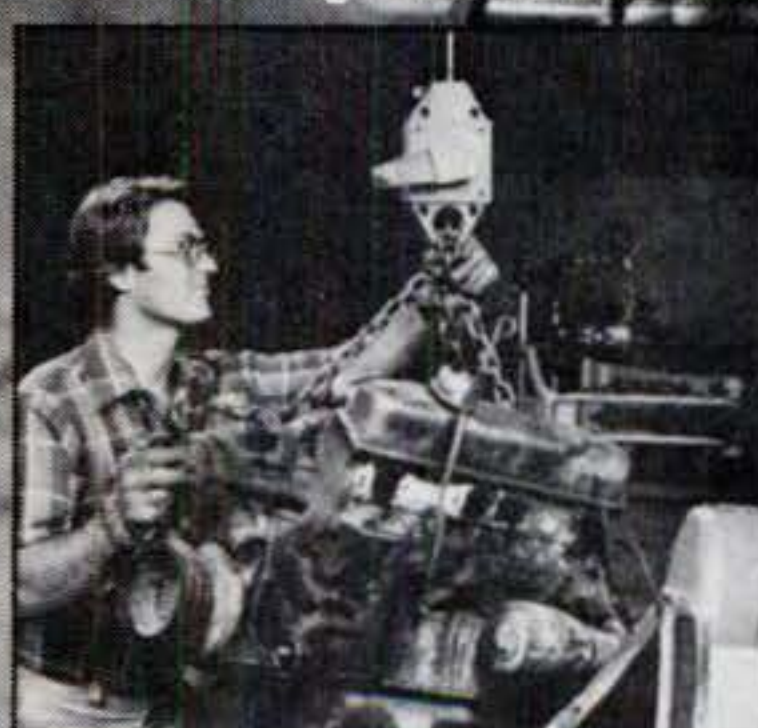
"It's My Kind of Load Handler"



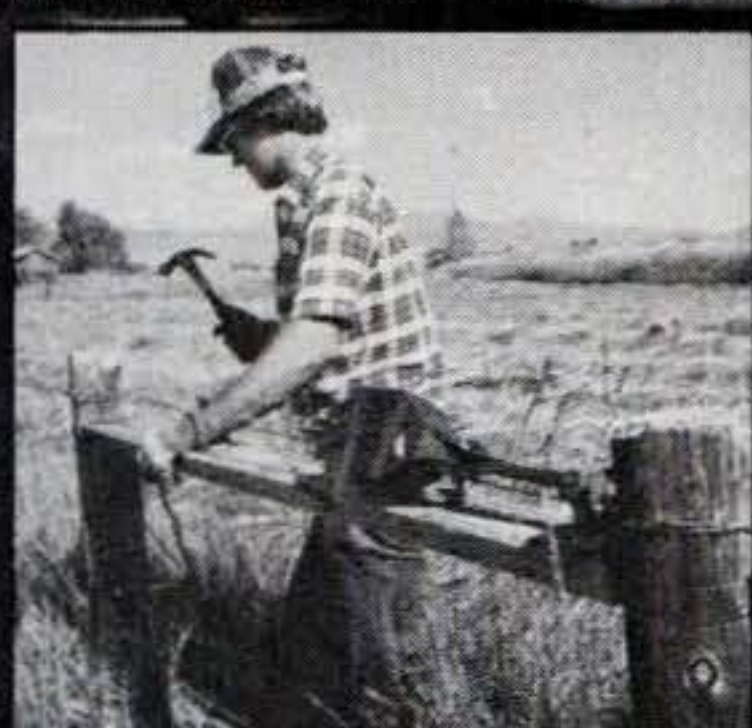
Many varied uses of this lightweight, inexpensive Load Handler make it a must for hoisting, winching, positioning and binding operations. It can be powered by an electric drill by using handy drill adapter (see order form). Shear ring protection plus infinite positioning with **no** back drive makes EASY TUGGER™ one of the safest units on the market today! Available in 1000 and 2000 lb. capacities ... starting at just \$82.50.

Fill in the handy order form and let us ship you an EASY TUGGER™.

Hoist an engine . . .



Stretch a fence . . .



Bind a load . . .



Pull heavy loads . . .

plus many other applications!

Order Form

Mail to: Tool Master, Inc. P.O. Box 2190
Boulder, CO 80306

PS 681

Please send me:

- ☐ 1000 lb EASY TUGGER™ with 12' cable @ \$82.50
- ☐ 2000 lb EASY TUGGER™ with 25' Cable @ \$116.50

Accessories:

- ☐ Universal Mount @ \$12.95
- ☐ Tail Hook @ \$13.95
- ☐ Pulley Block @ \$16.95
- ☐ Drill/Socket Assembly @ \$9.95
- ☐ Shear Rings \$3.75 (Box of 3)

LARGE QUANTITY DISCOUNTS AVAILABLE

CALL (303) 443-2290

Shipping and Handling

Add \$3.50 for each EASY TUGGER™

Add .75¢ for each Accessory

Colorado residents add 3% sales tax

☐ Please send more information.

Total Price _____

☐ Check or money order enclosed.

☐ Master Charge ☐ VISA ☐ Exp. Date _____

Acct # _____

Signature _____

Ship to:

Name _____

Street _____

City _____

State _____

Zip _____

Prices subject to change without notice. Please allow 4 to 6 weeks delivery.



Tool Master

Tool Master Incorporated
P.O. Box 2190
Boulder, Colorado 80306

Made in U.S.A.

SHOP TALK

By AL LEES

Old and New Testaments

Talk about coincidence! I'd just received a review copy of a new book by Contributing Editor R. J. DeCristoforo, titled *The Magic of Your Radial Arm Saw*, when my phone rang. It was another of my contributors, Howard Silken, calling to make PS readers a special offer on his book, *How to Get the Most Out of a Radial Arm Saw*.

"What gives, Howard?" I responded. "For years your spiral-bound book was the bible, included with every DeWalt saw. Now I'm thumbing through a new hardcover published by Reston for Black & Decker, DeWalt's parent company."

"I've been replaced," Howard explained. Seems B&D wanted an update—a book that would capitalize on the latest features and accessories and would simplify the earlier instructions.

Since both of these authors are power-tool pros, their books make for interesting comparisons. If you own a radial-arm saw, you may already have Silken's book; if not, Howard has bought the limited stock from B&D and offers copies to PS readers at a special price of \$3.95 (it retailed for \$11.95). He tells me he'll be happy to answer personal queries about radial-arm techniques if you enclose them with your check. Write: Howard Silken, 8676 Bridle Path Court, Davie, Fla. 33328.

The new DeCristoforo volume contains over 300 lavishly illustrated pages that cover not only the basic cuts but dadoing, routing, shaping, drilling, and—in typical Cris style—a batch of jigs and accessories you can make to extend your saw's performance.

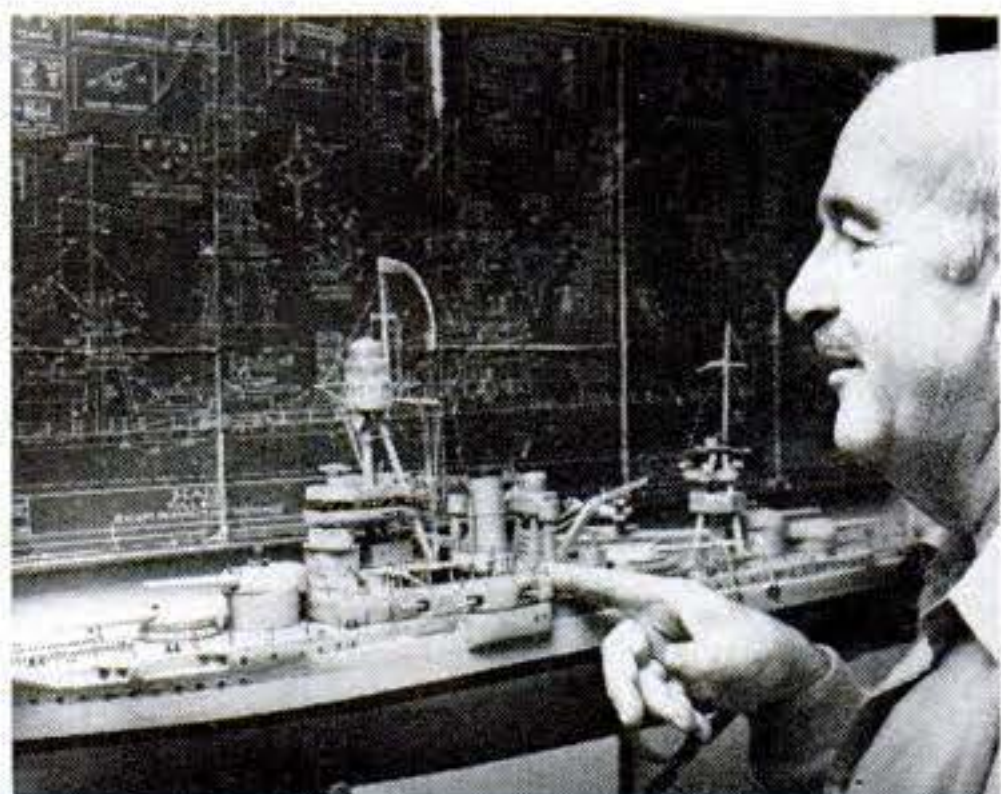
This book is priced at \$16.95 in stores, and will also be available at B&D Service Centers and as a premium with the higher-priced DeWalt models.

Both authors do all their demonstrating on DeWalts, of course, but most of the instructions apply to all other makes.

PS project took 48 years

Wonder if we have a record here: Andy Murphy of Maitland, Fla., sends me this picture of himself with a model of the battleship USS Texas, once the flagship of our Atlantic fleet. He's just completed it from plans we published in the five issues from November 1932 through March 1933.

"This could be one of the longest continuing projects in PS history," writes Andy. "I was a boy of 14 when I sent for the blueprint that went with your published instructions, which were written by Capt. E. Armitage McCann and edited by Arthur Wakeling, home workshop editor



at the time. School, college, and my career kept interfering with the completion of this model, which I made from scratch with wood, brass, and lead (none of the preformed plastic parts of today's kits).

"As I moved about the country over the years, I carefully packed the finished parts to take along. Last year's retirement finally gave me the time I needed to add the finishing touches, including the power plant wired up to tiny lights that was suggested in your articles. To Popular Science, my sincere thanks for a most delightful (though protracted) experience in model building!"

And our thanks, Andy, for sharing this experience. I passed along your note to my predecessor, Arthur Wakeling, who joins me in a 21-gun salute to your success.

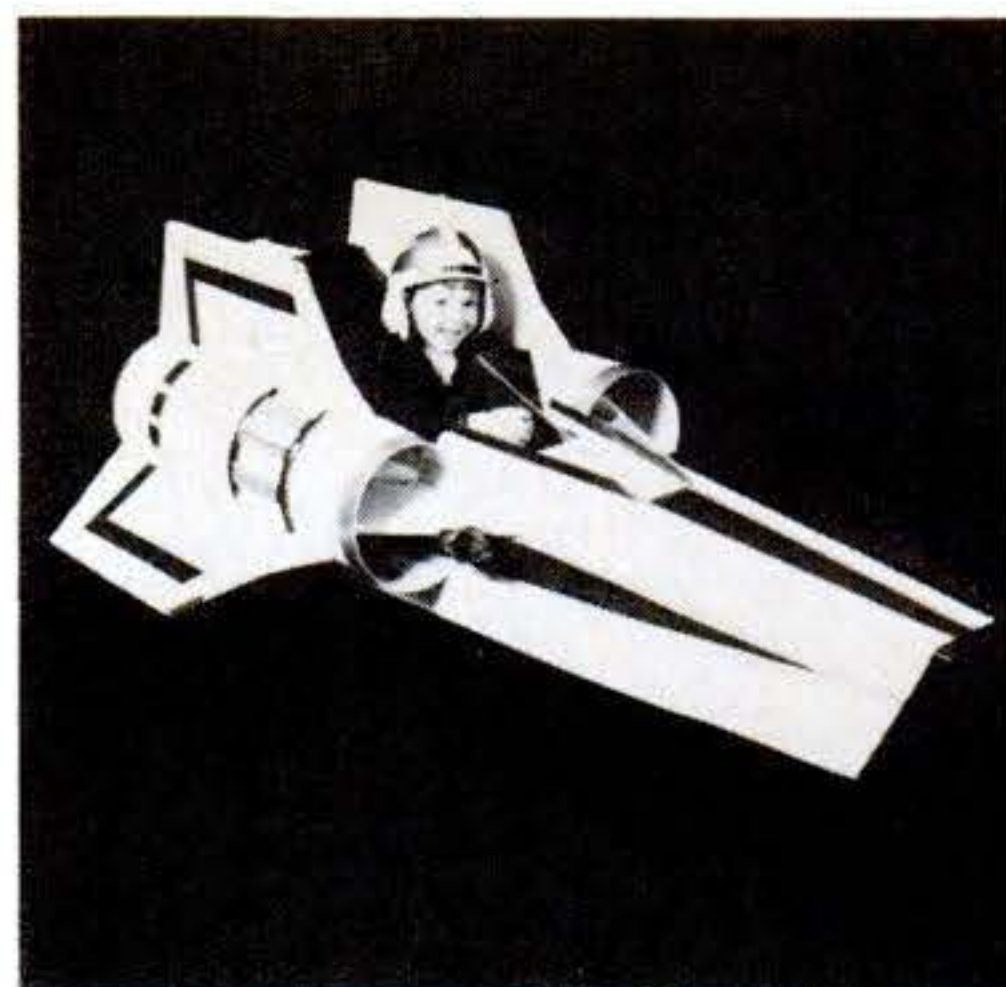
Alas, you were more diligent in your packing than we. All of the Capt. McCann blueprints for ship models were lost in one of several office moves PS made during this same period.

Author's correction

Contributing Editor Richard Day writes from his home atop California's Palomar Mountain: "A couple of errors got edited into my January article 'Solvent Welding Simplifies Plastic Plumbing.' Only polypropylene is used for chemically resistant fixture traps. Polyethylene and polybutylene pipe are used for cold and hot/cold pressurized water, respectively. None of the three types can be solvent-welded. Also, in the chart on page 117, the blue tint should have hit the box where the two CPVC columns intersect, indicating that this cement may be used with its own pipe type. (Incidentally, CPVC and all-purpose cements are practically the same.)"

Out to get Darth Vader

Reader Russ Robinson writes: "Our Star Ship electric sidewalk cart made such a hit in a local parade that we were besieged



with requests for plans. A good scrounger can put the craft together for under \$100 in a couple of weekends. It's powered by a starter motor, and hits 10 to 15 mph. Those jets are made from heating duct." Plans are \$10 from Russ Robinson, R.F.D. #2, Box 378C, Pleasant Grove, Utah 84062.

A tiger in your tank?

That new generation of in-tank toilet-bowl cleaners, which promise active cleaning of up to four months (while adding no color to the water), may be damaging metal and plastic parts of your flushing mechanisms. The culprit is calcium hypochlorite, the main chemical ingredient. Since these new cleaners don't meter out single dosages as the toilet is flushed, the longer the time between dosages, the stronger the concentration and the faster corroding can occur. So never use such cleaners at a summer home that's often vacant.

This warning comes from the Drackett Co. of Cincinnati, which was dissuaded by research from adding a hypochlorite product to its Vanish line this spring. It hastens to add that Vanish contains no corrosive ingredient—nor do any of these "tinting" cleaners: Blue Sani-Flush, Blue Boy, Ty-D-Bol, and Dependo.

Plywood ups gas mileage

I'm just back from the Tacoma, Wash., headquarters of the American Plywood Assn., where I judged the fifth annual PS/APA projects contest (winners to be shown in color in our August issue).

Several submissions were for canopies, caps, and covers for pickup trucks (one of these became a contest winner). These projects reminded Maryann Ezell, an APA staffer who helped me with the judging, of a clipping she'd been sent:

"Ford is sitting on a wild idea they didn't try to sell as an option for its light trucks: In the course of trying anything to cut down air resistance, they found that a 19-to-24-inch piece of plywood laid across the sides just ahead of the tailgate cut wind resistance.

"Seems the stream of air spilling over the cab is normally trapped by the tailgate, creating drag. A plank bounces this air out behind."

So if you drive your empty pickup without any cover, attach an airfoil and see if your mileage doesn't improve. **PS**

INTRODUCING THE LIFETIME ENGINE LUBRICATION PROTECTION PROGRAM.

Now, America's Number 1 selling motor oil introduces the most far-reaching protection program in the industry. Quaker State's exclusive Lifetime Engine Lubrication Protection Program...the program designed to help you keep your car running long and trouble-free.

LIFETIME PROTECTION. Any new car, van or light-duty truck engine can have guaranteed protection from Quaker State—in writing—against oil-related failure. For as long as you own it!

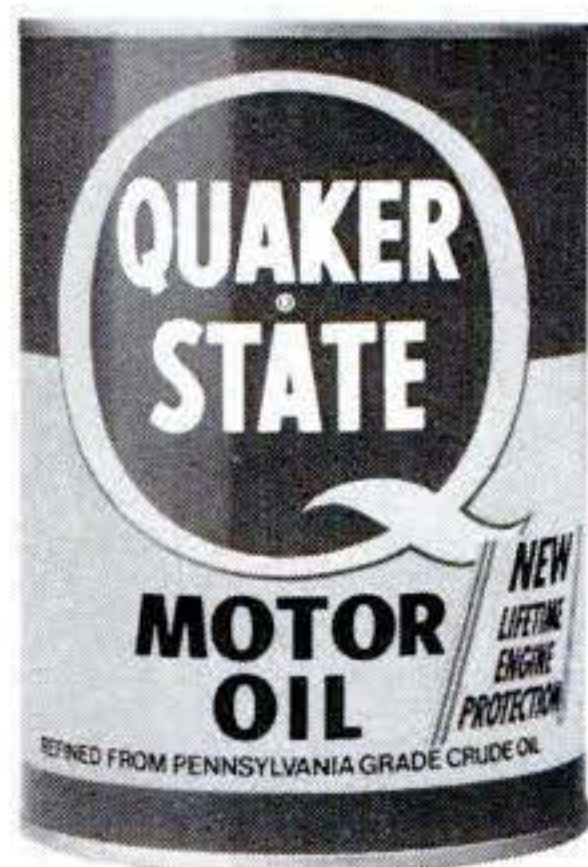
Quaker State Motor Oil protects so well, we guarantee that, if regular use of Quaker State ever fails to protect your engine, we'll pay for the repair or the replacement of all the affected oil-related parts. And we'll do it quickly.

In fact, in the event of a claim, Quaker State will arrange for a claim representative to contact you within 24 hours. Once you provide your copy of the Lifetime Engine Lubrication Protection

Program, all service records to verify compliance with the terms of the program and a statement of damage and repair costs, all work may be done in the repair shop of your choice at your earliest convenience.

GET ALL THE DETAILS. To obtain coverage and for details of limited warranty, see your participating new car dealer. He'll tell you how to qualify and how to keep your lifetime protection in effect. And don't worry...it's easy. Just ask for Quaker State's written Lifetime Engine Lubrication Protection Program.

QUAKER STATE: QUALITY FOR ALL CARS. Even if you're not driving a new car, you'll still want to use the motor oil that's refined from high quality Pennsylvania Grade Crude Oil and dares to guarantee its quality as well. So no matter what you're driving, new car or old, you'll be stayin' on the road with Quaker State.



STAYIN' ON THE ROAD WITH QUAKER STATE



Where do you find America's best golf and family vacation places?

RIGHT HERE.



When you make your vacation plans, think "Travel South USA." Follow the southern sun to some of the finest golf and vacation territory in the U.S.A. Treat yourself to the special southern hospitality of 11 "Travel South USA" states: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee and Virginia.

Get our TRAVEL SOUTH booklet on Golf and Family Vacations. Send this coupon with \$1.00 to cover postage and handling to:

TRAVEL SOUTH USA NAME _____
 3400 Peachtree Road, N.E. ADDRESS _____
 Atlanta, Georgia 30326 CITY _____ STATE _____ ZIP _____

"Antipic" Repels Mosquitoes

- No Vapors
- No Chemicals
- No Electrical Plugs

Combines latest Swiss Technology with Biological Research. A barely audible frequency protects you from biting mosquitoes. Convenient pocket size, 1.5v battery incl. Satisfaction guaranteed or your money back.

Gentlemen: Please send me _____ units of "Antipic" for only 19.95 each, plus \$1 shipping.

Enclosed is:

☐ cheque or money order ☐ M.C. or ☐ Visa

Card No. _____ Exp. Date _____

Name _____

Address _____

City _____

State _____ Zip _____

Signature _____

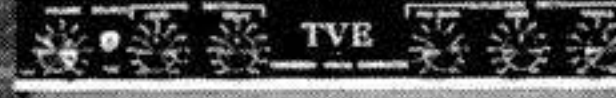
Send to: COLONIA IMPORTERS LTD. P.O. Box 340
 Lantzville, B.C., Canada, V0R 2H0

LEARN MEAT CUTTING



Train quickly in 8 short weeks at Toledo for a bright future with security in the vital meat business. Big pay, full-time jobs—**HAVE A PROFITABLE MARKET OF YOUR OWN!** Time payment plan available. Diploma given. Job help. Thousands of successful graduates. **OUR 58th YEAR!** Send now for a big new illustrated **FREE** catalog. No obligation. G.I. approved. **NATIONAL SCHOOL OF MEAT CUTTING**, No. 71-02-0197T, Dept. 51-Q, 33 N. Superior, Toledo, Ohio 43604.

A SINGER'S DREAM!



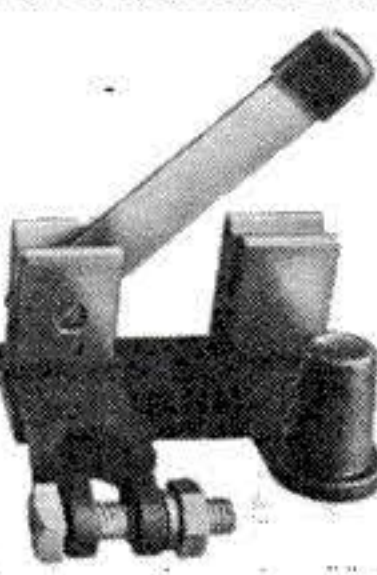
REMOVES VOCAL FROM MOST STEREO DISCS
 The Thompson Vocal Eliminator can actually remove most or virtually all of a solo vocalist from a standard stereo record and yet leave most of the background music untouched! Not an equalizer! We can prove it works over the phone. Send \$1 for a 24 page brochure and 20 minute demonstration record.
 Write to: **LT Sound**, Dept. PS, P.O. Box 338, Stone Mountain, GA 30086, Phone (404) 493-1258 **COST: \$249.00**

INVENTORS

The American Patent Law Association, a national lawyers association, offers a book and, if you choose, half hour consultation with a qualified attorney concerning the protection and commercialization of your ideas. Send \$15, check or money order, to

APLA, Box A
2001 Jefferson Davis Highway
Arlington, Virginia 22202.

NEW! SAFETY/SWITCH™ BATTERY DISCONNECT



Instantly disconnect battery power on cars, trucks, farm equipment, boats, R.V.'s. Stop battery drain on idle equipment. Avoid shorts and fires! Prevent theft of expensive machinery. Made of copper & brass for heavy duty service. Test to 750 amps. For all voltage systems. Only **\$18.95 plus \$1. shpg.**
 Send check or M.O. 20 day money back guarantee
HOLST, Inc. Dept. PS-681, 1118 W. Lake
 Box 370, Tawas City, MI 48763

The sun's violent flares

[Continued from page 69]

significantly broader during a spike burst. The timing of the broadening "demonstrates a physical link" between the burst and the process that broadens the lines, said Chris Rapley, an astronomer from University College, London.

The broadening of the lines could result either from rapid heating of the plasma or from highly turbulent motion. (High temperatures make atoms move faster, causing random red and blue shifts that broaden their spectral lines. Turbulent motion produces similar shifts through the motions of whole blobs of matter.) In either case, the observed behavior of the plasma conforms with the reconnection scenario.

One of the spectral lines produced did not match any normal plasma emission, but indicated ionization caused by the collision of a beam of high-speed electrons with the line-emitting atoms. This short-lived line came simultaneously with a spike burst, supporting the theory that reconnection accelerates particles.

Corona bombs

While uncertainty persists about flare mechanisms, astronomers have even more trouble explaining other disturbances they call coronal transients. On April 7, Solar Max's visible-light coronagraph recorded a transient resembling a huge loop as it flew outward into the corona. Correlation of this observation with one by a radio telescope in Australia showed that radio emissions produced by high-speed electrons were coming from material moving outward just behind the visible loop. Bill Wagner, a corona expert from the High Altitude Observatory in Boulder, Colo., added up the energies from these and other observations and reached a startling conclusion: The total energy of the transient was far greater than the output of the flare that produced it.

This suggests that solar flares, awesome in themselves, are just the triggers of much greater eruptions that release energy stored high above in the corona. It's as though the flare functioned as a lesser explosive setting off a hydrogen bomb.

Some of the solutions to the problems of solar flares and coronal transients may yet be hidden in the great store of data accumulated by Solar Max. But answers to the deeper riddles may have to wait until the sun delivers its next fireworks spectacular 11 years from now.

**Master
Shop
MULTI-TOOL™**

**separates the tools
from the toys!**

**...with cast iron components for
accuracy, durability and reliability!**

Master Shop uses machined and ground cast iron components just like the manufacturers of heavy industrial machine tools. Why? Because only cast iron can provide the perfect working surface, precision alignment, and reliability demanded by industry. Our rugged cast iron saw tables, arm bases, head rest and tailstock assure you a lifetime of trouble-free service. Master Shop combines the 5 most needed workshop tools in one affordable unit: 10" table saw, 34" lathe, 16½" vertical drill press, horizontal drilling machine, and 11¾" disc sander.

Enjoy the pride of accomplishment and achieve professional looking results on every project with the built in accuracy and versatility of Master Shop Multi-Tool. Repair furniture, remodel a room, make a picture frame or build a house. Even beginners find themselves equipped to comfortably tackle almost any project with the powerful, rugged Master Shop.

More value, quality and engineering for substantially less money than other multi-purpose tools.

Send for information or call today, and learn how easy it is to own the magnificent Master-Shop ... built for a lifetime of rewarding results.



MAIL TO:

**Master Shop, Multi-Tool Division • Dept. MJ 0116
ABCA, Inc. 3728 Benner Rd. Miamisburg, Ohio 45342
Phone (513) 866-5300**

☐ **Yes - I would like to learn more about Master Shop.
Please send me your information package**

NAME _____

ADDRESS _____

CITY _____ STATE _____

ZIP _____



"IN JUST 10 DAYS, I'LL SHOW YOU HOW TO DO

REAL MATH

ON YOUR SCIENTIFIC CALCULATOR!*

$$\int_a^b f \quad \frac{df}{dx} \quad \sum_{n=1}^{\infty} a_n$$

$\lim_{n \rightarrow \infty}$

•Quick.
•Easy.

•Guaranteed.
•Fun, too!

INTRIGUED BY CALCULATORS? Then you can step up your math skills fast! Use my new method in guidebook form. It's called **CALCULATOR CALCULUS** and comes with this guarantee: *If after 10 days you're not astounded at the problems you're solving on your own calculator, return the guidebook for an immediate refund.*

But the point is - you won't want to send it back. For this is the *easiest, fastest shortcut ever!* The day you receive your copy in the mail you'll want to put it to work. It's that exciting and helpful.

My name is Dr. George McCarty. I teach math at the University of California. I wrote this guidebook to cut through the confusion. It does just that - with worked-out examples, simple exercises and practical problems - all designed to work with precision and magic on your own calculator.

POWER METHODS. Need to evaluate functions, areas, volumes - solve equations - use curves, trig, polar coordinates - find limits for sequences and series? It's all here!

If you're in the biological, social or physical sciences, you'll be doing Bessel functions, carbon dating, Gompertz' growth curves, half-life, future value, marginal costs, motion, cooling, probability, pressure - and plenty more (even differential equations).

Important numerical techniques? Those algorithms are here, too -- rational and Padé approximation, bracketing, continued fractions, Euler's method, Heun's method, iteration functions, Newton's method, predictor-corrector, successive substitutions, Simpson's method and synthetic division.

LOOK AT WHAT USERS SAY. Samuel C. McCluney, Jr., of Philadelphia writes:

"CALCULATOR CALCULUS IS GREAT! For ten years I have been trying to get the theory of calculus through my head, using home-study courses. It was not until I had your book that it became clear what the calculus was all about. Now I can go through the other books and see what they are trying to do. With your book and a calculator the whole idea becomes clear in a moment, and is a MOST REFRESHING EXPERIENCE. I program some of the iterative problems you suggest and it

always GIVES ME A THRILL to see it start out with a wild guess and then approach the limit and stop."

Professor John A. Ball of Harvard College (author of the book 'Algorithms for RPN Calculators') adds:

"I wish I had had as good a calculus course."

Professor H. I. Freedman of the U. of Alberta, writing in *Soc. Ind. Appl. Math Review*, states:

"There can be no question as to the usefulness of this book...lots of exercises...very clearly written and makes for easy reading."

C.B. of Santa Barbara says: *"Your book has given me much instruction and pleasure. I do not hesitate to recommend it. 'CALCULATOR CALCULUS' inspires the reader to understand everything down to the last detail. You have put your heart into the teaching."*

I WANT YOU TO TRY THIS. So, if you act now, you can invest in 'CALCULATOR CALCULUS' for only U.S. \$14.95 (to USA or foreign: add \$1 for shipping, or \$4 by AIR; in Calif. add 90¢ tax).

***GET MY COMPLETE KIT**, with a TI-35 calculator, a 200 p. Student Math Book, AND the guidebook, ALL for \$39.95 (to USA only: add \$2 for shipping, or \$5 by AIR; in Calif. add \$2.40 tax). As pennywise Ben Franklin said, *"An investment in knowledge pays the best dividends."* **GET STARTED NOW** - Tax deductible for professionals.

NO RISK WHATEVER! Send for it today. Be sure to give me your complete mailing address with your check or money order. If you want to charge it (Visa or MC), tell me your card no. and exp. date. *Prompt shipment guaranteed.*

Thank you!

George McCarty

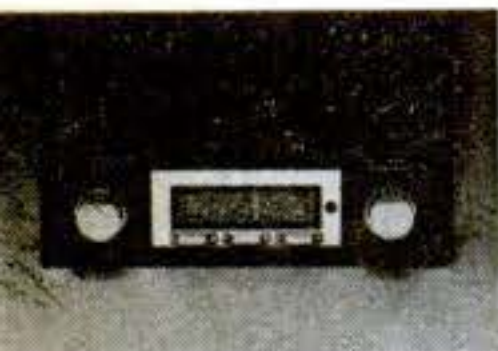
EduCALC Publications, Box 974, Dept. T5, Laguna Beach, California 92652
In California, call 714-497-3600; elsewhere
TOLL FREE 24-hour Credit Card orders: 800-854-0561, Extension 845; Dept. T5

FREE CATALOG!

Before you buy a car stereo, video system, personal computer, home stereo, telephone, or home security system, you need enough accurate information to make an intelligent buying decision.

Get this information by reading the informative *CRUTCHFIELD Catalog*. Easy to read articles and in-depth product comparison charts make it simple for you to buy sophisticated electronic equipment at low discount prices!

Order your FREE copy today at no obligation!



Select the ideal stereo for your car



Learn all about personal computers



Save by investing in your own telephone



Save on the latest in home stereo

Call or write now for your FREE catalog!

Use the coupon below or call toll free

800-446-1506

In Virginia call toll free 800-552-3961

- ☐ Send me your FREE catalog by Third Class Mail
- ☐ Rush me your FREE catalog! I'm enclosing \$1 for First Class Mail

Name _____

Address _____

City _____

State _____

Zip _____

CRUTCHFIELD

1 Crutchfield Park, Charlottesville, VA 22906
Department P

ARROW One hand operated STAPLE GUNS

Model
T-50

For the
Home
Handyman



All-purpose, professional staple gun with powerful hand compression staple driving action for 1,001 heavy duty jobs — like installing ceiling tile, insulation, weatherstripping, vapor barriers, etc.

Model ET-50
ELECTRIC



Operates
on any
110 Volt
AC-60 Cycle
Outlet.

For the
Handy
Homemaker



Lightweight electric staple gun that works on standard household current. Easy-squeeze trigger-fast operation makes it tireless for women to use as well as men.

Manual or electric... Arrow Staple Guns make fast, effortless work of those do-it-yourself home fix-up projects! Easy one hand operation leaves other hand free to hold, stretch and control material for that professional finishing touch... whether you're a home handyman insulating an attic or a handy homemaker covering a valance. Both models use Arrow No. T-50 staples in 6 sizes: 1/4", 5/16", 3/8", 1/2", 9/16" and Ceiltile.

Available at all leading Hardware, Home Center & Discount Department Stores everywhere.

Arrow Fastener Company, Inc.
271 Mayhill Street, Saddle Brook, N. J. 07662

Air tools

[Continued from page 103]

pler with built-in air cutoff and male couplers. The master coupler installs at the end of your air hose. The 1/4-inch pipe threads (or 3/8-inch in a large-air-draw installation) make a direct fit. A male coupler—with either male or female pipe threads—screws to the air inlet of each air tool. Plugging a tool into the hose then takes only a second. It's off just as quickly.

Filter. If you do much critical paint spraying, you'll want an air-line filter. Some are made to hook to your belt as you spray. A filter prevents water and oil droplets from spoiling a paint job. Main-line tool oilers are also available, but they are not recommended.

Extra air hose. To extend the reach of your air tools, it's handiest just to wheel the compressor. But additional air hose may be desirable. It should be at least 5/16 inch to prevent excessive pressure drop between compressor and tool, especially on high-draw air tools. Even the 3/8-inch-I.D. air hose is not too big for good air flow. You should try to hold air-line pressure drop to five psi or, at most, 10 psi. Handiest hose of all is the self-coiling type, available in 1/4 and 3/8 inch. Flexible whip hoses, sometimes used at each tool, are 1/4 inch, but only a couple of feet long. If you need a longer reach, it's better to use extra air hoses.

Portable air tank. This is another handy accessory. Usually with about nine-gallon capacity, it fills and holds air via a Schrader valve. The tank often comes with a pressure gauge and short hose with tire chuck. An air tank may be filled by your compressor or by the local service station's air hose. (Unless you're a good customer, better ask first.) Unfortunately, a portable tank does not contain enough air to change a flat tire with an impact wrench. This proves a strain even for a 20-gallon compressor tank full of air. A nine-gallon portable tank sells for under \$40.

Compressor basics

The basic air compressor for use with air tools comes with motor, 12- or 20-gallon lightweight or heavy-duty ASME storage tank, tank-pressure gauge, adjustable pressure regulator with gauge, safety blowoff valve, and pressure switch with automatic unloader. It should be capable of producing at least 90 psi or, better yet, 120 psi and up.

Other compressor considerations are horsepower and air delivery in standard cubic feet per minute (scfm).

Rechargeable Aerosol Spray Can!

New British Invention...

Make your own aerosol spray paints, cleaners, lubricants, etc. and save yourself a small fortune.

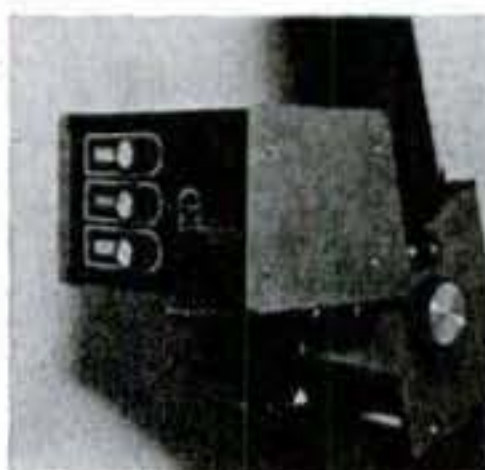
Environmentally Safe — No Fluorocarbons

Re-fill the Rechargeable Aerosol Can and use it over and over... it actually makes a great deal of sense. When you go to the store and purchase spray paint or any other liquid aerosol spray, you usually pay more for the aerosol canister (plus the cost of filling and pressurizing it) than for the contents. Push-button convenience has been most expensive... but now you have an ingenious and easy alternative.

Fast and simple to operate... Fill the can 2/3 full with the liquid to be used, thinning according to instructions. Screw on the Aerosol Valve Top and pressurize to 50 psi with any bicycle pump, air hose or other air source (a unique pressure relief valve insures against overcharging). When the large (1 pint) can is empty, simply re-fill and pressurize. You're back to the job in minutes. When finished, clean the can thoroughly and you're ready for your next project!



Touch-up body work



Clean photo equip.

Genuine Professional results... without the noise and hassles of a cumbersome and expensive compressor. Starshine's Rechargeable Aerosol is a quality spraying instrument... the first of its kind for home, garden and industrial use. It is available only from Starshine's Mail Order Sales Division and arrives quickly at your door complete with two interchangeable spray heads. One, a wide angle spray, is for flawless application of paints and other liquids requiring an even coating. The other, a special extension tube, is for applying lubricants, cleaners, etc., in hard-to-get-at places such as complex electronic equipment.

For example, a few suggested uses:

- Paints
- Lubricants
- Rust inhibitors
- Solvents
- Engine degreasers
- Photo equipment
- De-icer
- Household cleaners
- Insecticides
- Disinfectants
- Electrical contact cleaners
- A world of applications



Paint metalwork



Lube office equip.



Large size can: 2 1/2" W x 8" H

Tough, precision construction plus Starshine's exclusive 5-year guarantee. Designed in England, the solid canister is one-piece aluminum with no seams to come apart. The aerosol valve body is also solid aluminum and knurled for easy handling. Should your Starshine Rechargeable Aerosol ever malfunction due to a manufacturing defect within 5 years, you may return it for repair or replacement at our prompt service-by-mail facility. We pride ourselves on our quick, courteous service.

Test it yourself at home or work for 2 weeks... with no obligation.

Order Toll-Free: 800-235-6945 or if busy 800-235-6951

CA residents call: 805-966-7187 or send coupon.

- ☐ Please send by return mail one Starshine Rechargeable Aerosol @ \$19.95 (plus \$2 shipping and handling). If not completely satisfied, I may return within 2 weeks of receipt for a prompt refund with no questions asked.
- ☐ **Save \$4 or more!** Order two or more Aerosols at the quantity price of only \$17.95 ea. (plus \$2 shipping and handling ea.)
- ☐ Check or money order enclosed (CA residents add 6% sales tax)
- ☐ Charge my credit card number listed below
- ☐ BankAmericard/Visa ☐ Master Charge (Interbank no. _____)
- ☐ American Express ☐ Diners Club ☐ Carte Blanche

Credit Card No. _____

Exp. Date _____

Name _____

Address _____

City/State/Zip _____

STARSHINE GROUP

924 Anacapa St., Dept. AC501 Santa Barbara, CA 93101

Copyright Starshine Inc., 1980

typical horsepower figures for a homeowner-style air compressor range from 1/2 to five. Most likely, the one you need falls between those extremes, say one or two hp. As for scfm, compressor output should match the air use of the heaviest-drawing, continuous-use air tool you expect to use. Sprayers, sanders, drills, and hammer-chisels are considered continuous-use air tools. Others, such as impact wrenches, rest between uses and should not be scfm determiners.

As you might guess, a compressor's air delivery depends on its horsepower. Delivery also depends on compressor efficiency. And because air delivery drops as pressure increases, scfm or compressors are given at two pressures, typically 40 and 90 psi.

To tell what size compressor you need, look up the scfm figures for your largest-drawing, continuous-use air tool in Table A and go to Table B to see what compressor is needed. Also double-check the scfm and horsepower figures on the actual compressor you plan to purchase. The figures given may not apply specifically to a compressor. In Table A the scfm ranges allow for various makes and sizes of air tools.

You may find that a one-hp (three-gallon gasoline) compressor will handle your needs. Expect to pay \$250 to \$400. However, a larger two-hp (four-gallon gasoline) unit will do a better job. It costs \$350-\$550. There are few air tools the higher-hp models will not handle. When in doubt, go for the larger compressor. Playing catch-up with a too small air compressor is maddening. A larger tank is no help, either. It merely forestalls the wait.

Air-tool maintenance

Install your compressor where it will not draw in dust produced by air-tool use. That will help lengthen its life. Follow the manufacturer's instructions on electrical wiring, lubrication, and maintenance.

Air-powered tools need one drop of oil every day they're used. It's amazing how many mechanics like Marvel Mystery Oil for this. Special air-tool oil, light machine oil, or automatic-transmission fluid also may be used. Put the drop into the tool's air inlet after each daily use, then store it so the oil will run down into the air-line motor. Wipe off the outside of the tool regularly, too. Air-pressure tools, such as sandblasters, need no oiling.

Here's a Catch-22 of tools. Air sand-

Continued



The Cart That Made The Wheelbarrow Obsolete!

3 Sizes Available.

Send for FREE
CART CATALOG
Today

Carry Ten Times A Wheelbarrow Load With INCREDIBLE EASE!

These BIG, strong carts are perfectly balanced on two huge wheels — roll easily over lawns and gardens — carry up to 400 lbs. of load — huge volume capacity means you make fewer trips — you'll save time and steps.

If you are still struggling with a wheelbarrow or inadequate cart (with tiny wheels) send for FREE Cart Catalog. Build it yourself kits, too.

© 1981 Garden Way, Inc.

GARDEN WAY RESEARCH
Charlotte, Vermont 05445

CARTS c/o
GARDEN WAY RESEARCH
Dept. A1229C
Charlotte, Vermont 05445

☐ Please send FREE
CART CATALOG.

Name _____
(Please Print)

Address _____

City _____

State _____ Zip _____

Enjoy SATELLITE TV Now



Save thousands of dollars!

Now you can choose from three complete systems, which have the same superb electronics. Prices are: 10 ft. dish **\$2495**, 13 ft. dish **\$2595**, and our 16 ft. (5 m.) dish system for only **\$2695**. Complete system has dish antenna, feed horn, polarity rotor, LNA, cables, receiver and TV modulator—everything. Why pay more? Our 16 ft. system will outperform any 10 ft. system—even those costing thousands of dollars more. Satellite TV is so much better than simple Cable TV. More selection, news, movies, sports, Vegas shows, Spanish, French, Russian, religi-

ous, plenty of family and adult entertainment. Over 20 program services on just one satellite. You get perfect color and crystal clear reception, especially with our larger dishes that connect to any TV set. And to a whole condo or apartment complex! Have your local dealer install one or do-it-yourself in a weekend.

Don't wait any longer. Our big (8×11 in.) Handbook is loaded with details, photos, aiming data, and signal strength maps. Explains how much system you need. For the do-it-yourselfer, we show where to find full schematic plans and circuit boards. **Satisfaction Guaranteed.**

GLOBAL TV ELECTRONICS, INC.

235 S. Maitland Avenue
P. O. Box 219-A, Maitland, Florida 32751

Send **\$7.95 Today!** Add \$2.00 for first class (airmail). Canadian send \$10.10 US or \$12.50 Canadian, Foreign send \$12.00 US funds - airmail only. Or in the USA, call our 24 hour C.O.D. order line **1-305-862-5068** now.

Name _____

Full Address _____

Zip/PC _____

Air tools

[Continued]

ers used on surfaces to be painted should not be oiled if you wish to avoid heavy degreasing. Yet if you don't oil them, they'll eventually freeze up and have to be junked or repaired. The answer is either very light oiling so that no excess oil bleeds from the tool's exhaust ports—a neat trick you can do it—or using a National orbital-pad sander, which seems to run indefinitely without oiling.

When you shop for air tools, you'll find three qualities available: industrial, professional, and do-it-yourself. Forget industrial quality unless you really need air tools so well built that they cost more than \$300 each. These tools are built to standards beyond what you'd need for use at home. They're made to run continuously while supplied with proper line-oiling and designed to be fully serviceable. Furthermore, many are significantly heavier than home and shop tools since they are intended for counter-weighted support from above when in use. Instead, select air tools from either professional or do-it-yourself quality.

Lots of pro-quality air-power tools sell for \$75 to \$100. If you want good service and can afford to spend the money, go for these. They are lightweight and are designed for automotive and trades use under tough but not continuous service. They feature serviceable design, quality materials, and careful workmanship, provide plenty of power for fast working, and may be repaired when necessary.

But if you're on a budget, the DIY-quality air-powered tools at \$50 and even less will get you into air most easily. These tools are practically all imported, built to sell at low prices. While they, too, may be repaired, the best bet is to discard and replace them when they give up. In occasional use, if you're lucky, some of the better ones may last you a lifetime.

FOR FURTHER INFORMATION

Black and Decker Mfg. Co., Towson MD 21204; Campbell-Hausfeld, Harrison OH 45030 (paperback book recently published at \$5 postpaid covers compressors and air tools in depth); Chicago Pneumatic Tool Co., 2200 Bleecker St., Utica NY 13501; Executive Trading Co., P.O. Box 35558, Los Angeles CA 90035; Ingersoll-Rand Co., Tool and Hoist Div., 28 Kennedy Blvd., East Brunswick NJ 08816 (industrial-quality tools, but huge selection); Montgomery Ward and Co., 619 West Chicago Ave., Chicago IL 60607; National-Detroit, Inc., P.O. Box 2285, Rockford IL 61131; J.C. Penney Co., Inc., 1301 Avenue of the Americas, New York NY 10019; Rockwell International, Power Tools Div., Suite 600, Popular Towers, 6263 Popular Ave., Memphis TN 38138; Rodac Corp., 1005 East Artesia Blvd., Carson CA 90746; Sears Roebuck and Co., Sears Tower, Chicago IL 60684; Silver Hardware Co., 2205 Richmond St., Philadelphia PA 19125; Skil Corp., 5033 Elston Ave., Chicago IL 60630; Snap-On Tools Co., 8028-28th Ave., Kenosha WI 53140; U.S. General Supply Corp., 100 Commercial St., Plainview NY 11803; J.C. Whitney and Co., P.O. Box 8410, Chicago IL 60680.

My Wife And I Drilled A Well

Robert Mackey

When I told my friends I was going to get a Hydra-Drill and try to drill a water well, they advised me to forget it. "Look," they told me, "if commercial drillers don't want to drill here, there must be a good reason."

Unfortunately for me, the section where my home is located is famous for very difficult drilling. There are big granite boulders all over the place. You look at them and you can just imagine what it must be like down deep in the ground. That's the reason most commercial well drillers around here don't try to drill in this area; the few who will try get \$22 a foot.

My friends were sure I couldn't succeed, but I'd read that thousands of people all over the world have drilled wells with Hydra-Drills. Besides, I have a positive attitude in matters like this: If someone else can do it, so can I.

OUR FIRST HYDRA-DRILL WELL

Drilling a water well was a brand new experience for me. I wasn't sure how deep I'd have to drill or how long it would take, but my wife got interested in the project and volunteered to help.

We knew we'd be drilling a lot of rock and we expected it would go slowly. We agreed to take it in easy stages and follow the instruction book step by step. The big question was whether the Hydra-Drill could handle all that hard rock. As it turned out, we had to drill through six boulders, and our drilling speed slowed to a few inches per hour. However, between the boulders we zipped along at close to a foot a minute. Not bad, not bad at all!

It wasn't until we reached a depth of 93 feet that we hit water. Then I took a mirror and reflected sunlight down the hole. We were delighted to find we had drilled a



very straight hole, and we could see water 93 feet below us.

In this area of Nevada, it's sometimes possible to drill a hot water well. The temperature of the water varies from 150 to 200 degrees which is hot enough to use for home heating. These hot water veins are usually between a hundred and two hundred feet deep, and if you're lucky enough to find one under your property, you'll never have to pay another fuel bill.

In hopes of finding hot water we continued drilling to a depth of 123 feet; at that point we had 30 feet of water standing in the well. We measured the temperature and it was 155 degrees. We are now using that water to heat our entire house.

We plan to drill some more wells on our property. We're delighted to have the hot water well; now we'd like to drill a cold water well.

The remarkable part is that we had absolutely no experience in well drilling, and here we were drilling in very difficult conditions. We went through blue clay, red clay, decomposed granite and six boulders. The Hydra-Drill performed just great.

I doubt there are many places

where the drilling conditions are rougher than what we have here, and to anyone interested in drilling a water well, I certainly recommend the Hydra-Drill.

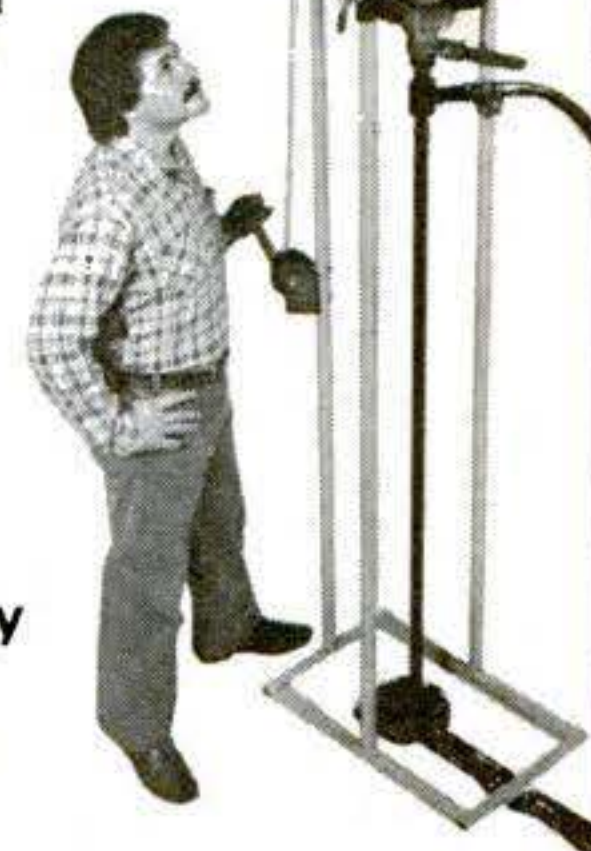
NOTE: Popular Science readers can get a big, fully illustrated information kit on the Hydra-Drill including a booklet, "How to Drill Your Own Well". The information kit is available free, without obligation. Requests should be addressed to DeepRock Mfg. Co., 5402 Anderson Road, Opelika, AL 36802.

WEEKEND WELL DRILLER

SAVE HUNDREDS OF DOLLARS

For less than \$1 per ft. you can drill a water well in your backyard next weekend!

Have all the pure, fresh water you want FREE! The HYDRA-DRILL drills water wells 50 to 200 feet deep. Easy to operate as a power lawn mower!



FOR FREE BROCHURE ON HOW TO DRILL A WELL

CALL TOLL-FREE (800) 821-2280

Ask for Ext. 5402

*Call anytime including Sundays. OR CLIP COUPON AND MAIL TODAY!

DeepRock Mfg. Co.
5402 Anderson Road
Opelika, AL 36802

Please mail your free information kit immediately. I understand there is no obligation and no salesman will call.

Print Name _____

Address _____

City _____

State _____

Zip _____

©1981 DeepRock Mfg. Co.

HOW TO

SAVE ENERGY

Energy saved is money saved. A good and easy way to start saving is to seal your home with Red Devil caulks and fillers—there's one for every caulking need. Pay special attention to frames of doors, windows and air conditioners, the foundation, and cracks in mortar



and concrete. Ask your dealer for a free copy of Red Devil's brochure, "How To Save Energy", or send a stamped, self-addressed, business-size envelope to: Red Devil, Inc., Box 155E, Union, NJ 07083.

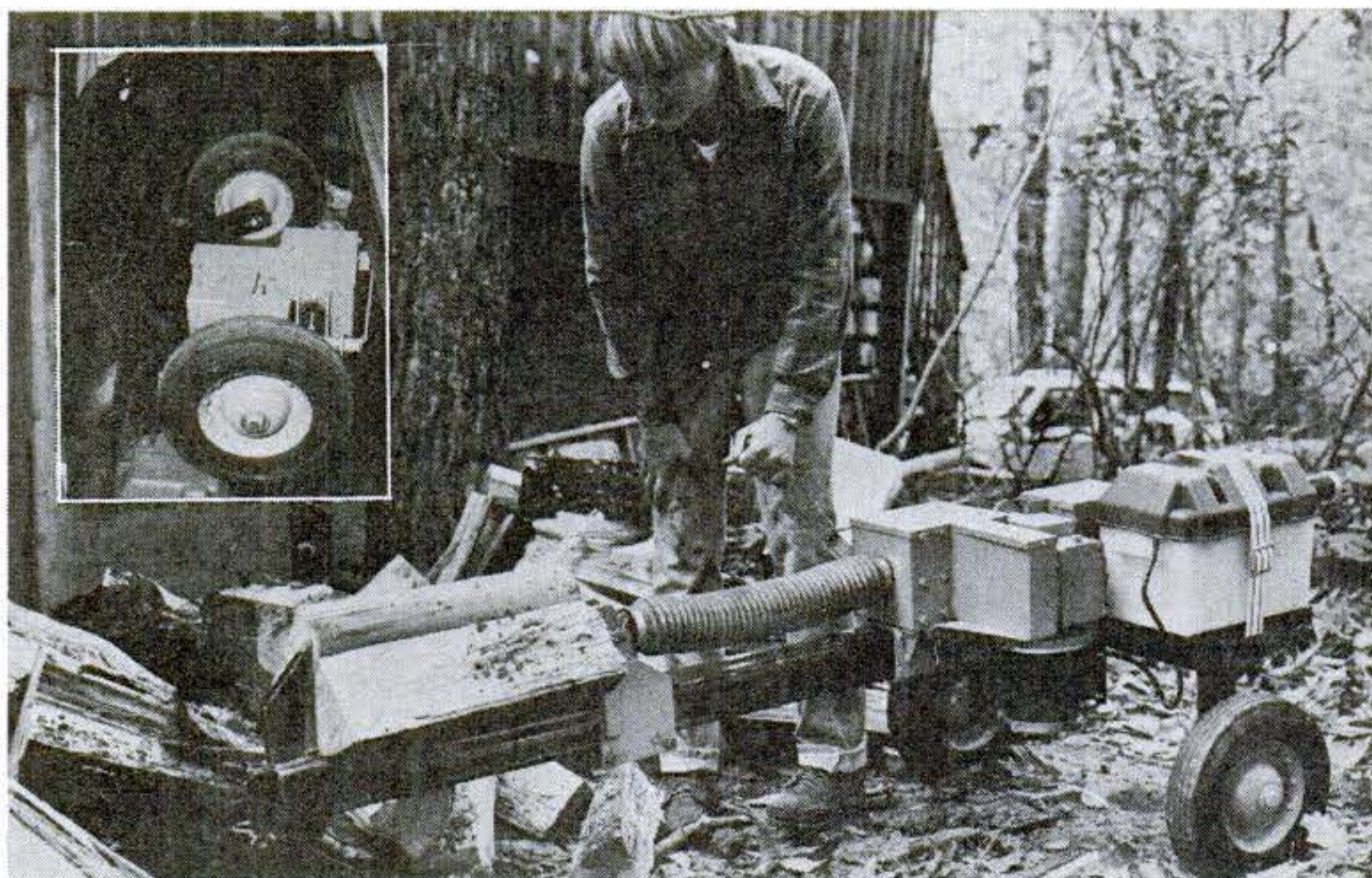


Red Devil

Red Devil, Inc., Union, NJ 07083

WE'RE SOLD ON QUALITY.

Battery-powered modular log splitter



Standard splitting force is 11,600 psi, which is adequate for logs 20 inches in

diameter. Pull two pins and the splitter breaks down for easy stowing (inset).

An electric log splitter that can be trailered, carried in a truck, or put in the trunk of a compact car? By one man? I was skeptical. But a day later David Tjesvold of Yukon Industries drove into my driveway with the splitter neatly packed in the trunk of his Zephyr.

The splitter is modular—two pins hold it together. Pull one pin to remove the boom and another to take off the wheel assembly. That leaves only the 85-pound power unit, the heaviest component, to stow in one piece. Minutes later it's together and operating.

The splitter handled my "torture test" woodpile admirably (some of the toughest wood I could find). The only casualty: a vulnerable limit switch, which is being moved to a safer position in production models.

The power source for the splitter is a 2.25-hp, 12-volt permanent-magnet motor made by American Bosch. It turns a 10:1 reduction gearbox that drives the threaded shaft using a sprocket, #40 roller chain, and recirculating ball-and-worm final drive. The ram is attached to the forward end of the threaded shaft. With stock gearing, it develops a splitting force of 11,600 psi. With one of the optional gearbox sprockets and chains, it quickly adapts to 15,200 or 18,700 psi, but at some sacrifice in speed.

In use, the log is placed on the beam

next to the wedge. The key switch is turned on and the operating lever moved to the forward position. The ram pushes the log against the slim wedge and splits it. The forward angle of the wedge helps prevent the log from lifting. If the ram stalls, a self-resetting overload protector quickly stops the motor.

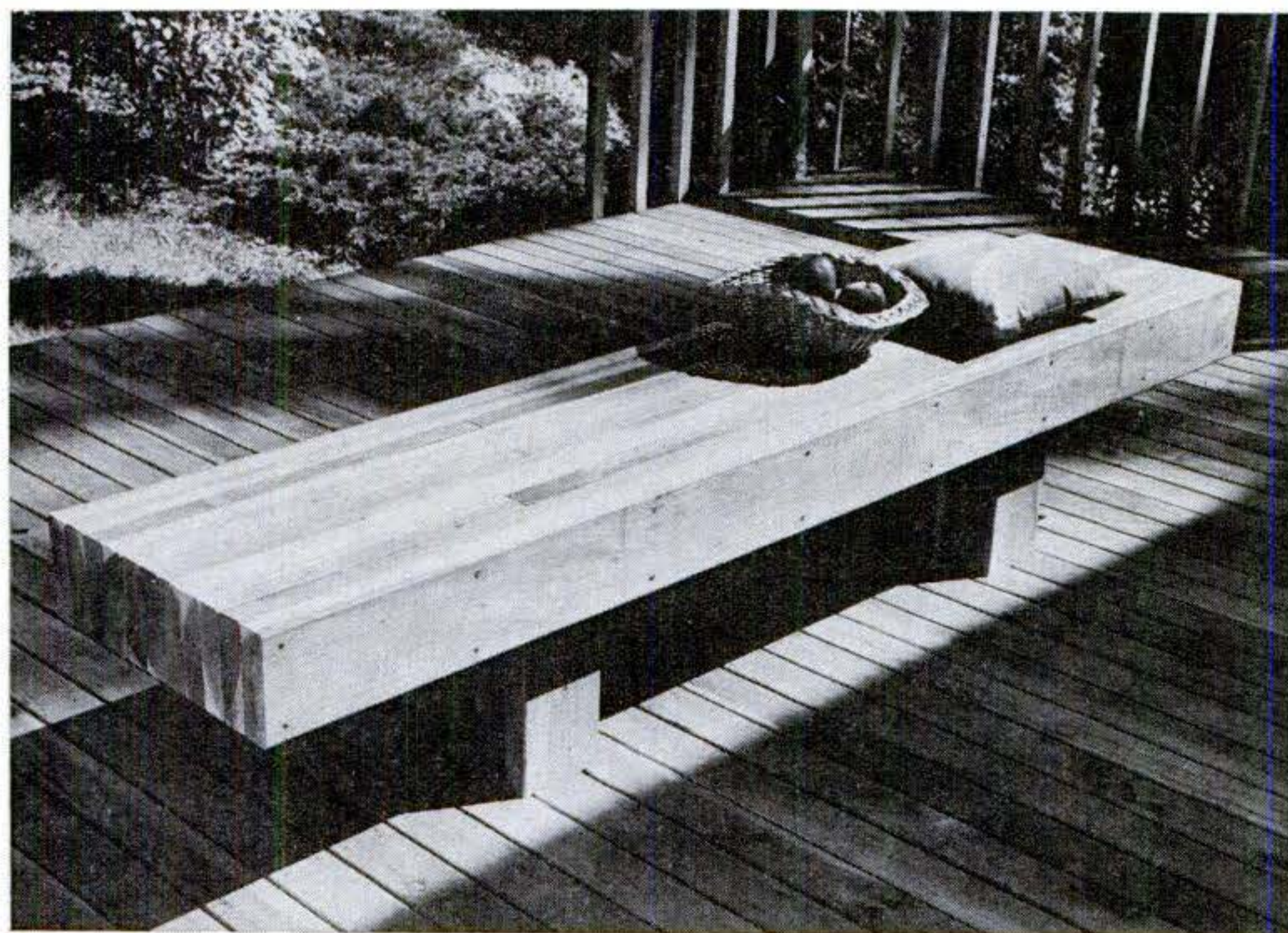
As the log moves forward, a limit switch stops the ram just short of contact with the wedge. As soon as this occurs, you move the operating lever to the rear position and the ram immediately retreats to a point determined by the rear limit switch. (This can be adjusted to accommodate the length of logs being split.)

Options for the electric log splitter include wedge wings to part the wood, trailering wheels, and a permanent stand mount.

My test splitter has been in use almost daily and has established quite a following in my neighborhood. It will run all day on a fully charged marine battery, but you can also use your car battery with jumper cables for short periods.

Besides moving one of the limit switches, production models will have stronger sides on the ram pusher for heavy-duty use. Yukon (9890 N.E. Highway 65, Minneapolis, Minn. 55434) intends to sell the splitter for substantially less than the cost of a hydraulic unit.—Evan Powell

For sturdy good looks, try butcher-block construction



Simple but handsome pieces are easy to build with butcher-block construction.

A handsome bench or rugged steps—you build 'em both with the same simple technique

By BILL HAWKINS

Simple hammer-and-saw construction is at its best when you think butcher-block: Rugged, handsome projects can be built in just a few hours and—if you use redwood—they'll last through years of abuse from weather or people.

Shown here are two similarly fabricated backyard projects: a deck bench for the patio, and butcher-block steps for the entrance to your house or patio. Since they were designed for the

This bench can be built from construction heart or common 2×6 redwood lumber.

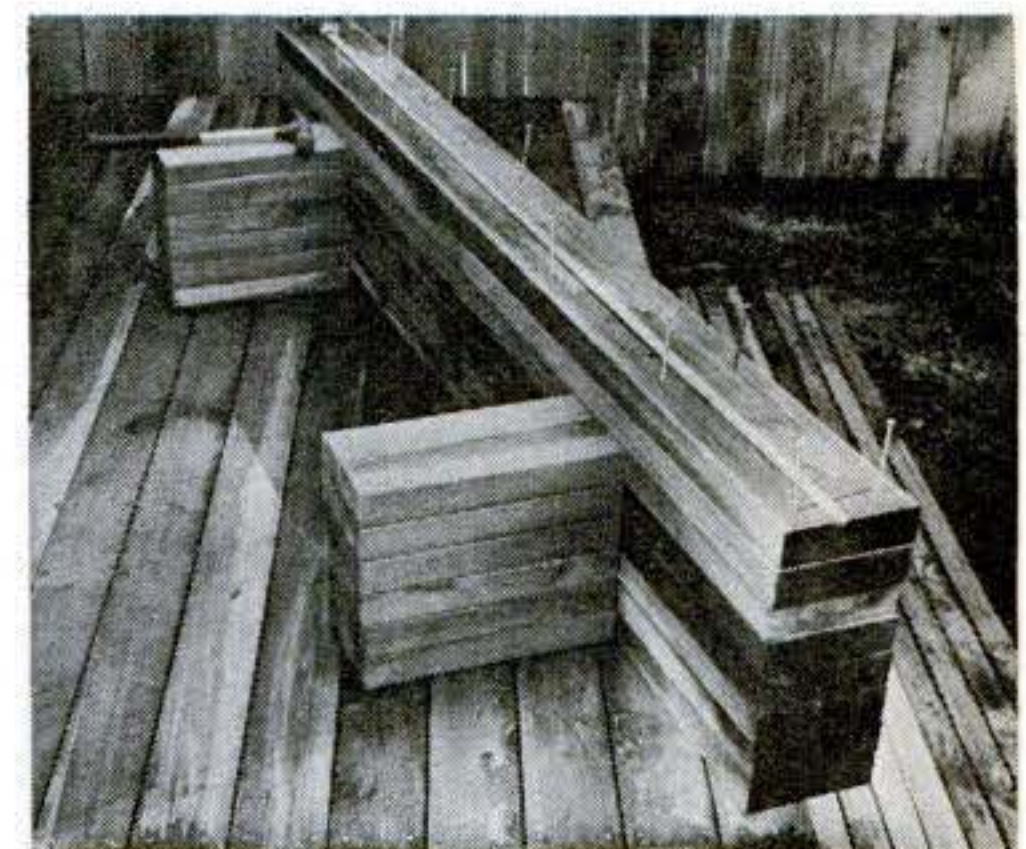
California Redwood Assn., it's not hard to believe that redwood is the suggested lumber. CRA says to treat it with a water repellant containing a mildewcide before assembly, plus a second coat after it's nailed together. To avoid corrosion stains, use hot-



Bench legs are made of five 12 $\frac{3}{4}$ -inch pieces sandwiched between two 18-inch outer supports. To start, nail just one support to stack; second nails on later.



Open end of leg support is nailed to edge of bench top. Fill spaces between legs, and from legs to sides, with 2×6's. Be sure top edges are splinter-free.



Nail two 2×6's on outside of bench legs to complete first side. Flip over, nail second outer support to legs. Complete with 2×6 fillers and two last top pieces.

dipped galvanized 16-penny nails throughout the projects.

The butcher-block bench is 18 inches high, 18 inches wide, and can be four, six, or eight feet long. Use construction-heart grade lumber for

Continued

BUTCHER-BLOCK BENCH—your choice of three lengths, and 2×4 or 2×6 construction

	<u>2×6's needed:</u>	<u>Pieces cut to:</u>			
Bench legs:	(2) 12 ft.	(4) 18 in. (12) 12 $\frac{3}{4}$ in.			
Bench:	<u>Length</u>	<u>Long pcs.</u>	<u>Short pcs.</u>	<u>Inserts</u>	
4 ft.	(6) 8 ft.	(10) 4 ft.	(4) 9 in.	(2) 18 $\frac{3}{4}$ in.	
6 ft.	(12) 6 ft.	(10) 6 ft.	(4) 12 in.	(2) 36 $\frac{3}{4}$ in.	
8 ft.	(12) 8 ft.	(10) 8 ft.	(4) 16 in.	(2) 52 $\frac{3}{4}$ in.	
	<u>2×4's needed:</u>	<u>Pieces cut to:</u>			
Bench legs:	(2) 14 ft.	(4) 23 $\frac{3}{4}$ in. (12) 20 $\frac{3}{4}$ in.			
Bench:	<u>Length</u>	<u>Long pcs.</u>	<u>Short pcs.</u>	<u>Inserts</u>	
4 ft.	(6) 8 ft.	(10) 4 ft.	(4) 9 in.	(2) 22 $\frac{3}{4}$ in.	
6 ft.	(12) 6 ft.	(10) 6 ft.	(4) 12 in.	(2) 40 $\frac{3}{4}$ in.	
8 ft.	(12) 8 ft.	(10) 8 ft.	(4) 16 in.	(2) 56 $\frac{3}{4}$ in.	

DIRECT FROM U.S. OPTICS QUALITY SUNGLASSES AT FACTORY PRICES

Each pair features: Impact resistant lenses • Handcrafted • Polished glass lenses • Hardened metal frames • No non-sense guarantee.

FREE—limited time only—deluxe velour lined case with each pair of glasses ordered (a \$3.00 value). Credit cards accepted. Dealer inquiries invited.

NOTICE: Don't be fooled by cheap imitations. These glasses are made exclusively for U.S. Optics. To make sure you get the best, order now and if not completely satisfied return for refund within 30 days.



Only
\$7.95

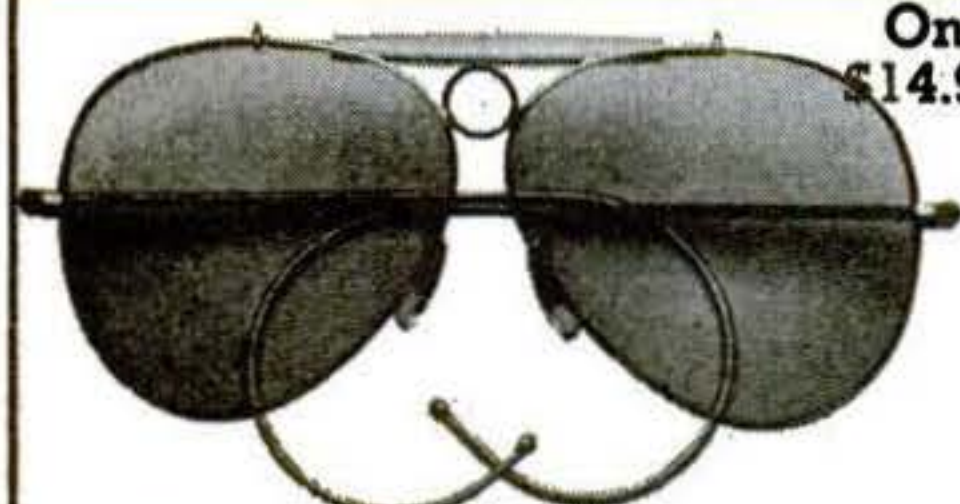
World Famous Pilot's Glasses

These precision flight glasses are now available to the public for only \$7.95. If you could buy them elsewhere, they'd probably cost you over \$20.00. #20P available in gold or silver frame. A \$20.00 value only \$7.95. Two pairs for \$14.00.



Only
\$9.95

Aviator Teardrop Flight Glasses
Flexible cable temples. #30A gold frame only. A \$30.00 value only \$9.95.
2 pairs for \$18.00.



Only
\$14.95

Professional Driving & Shooting Glasses
Wide angle amber lens brightens visibility. #30D gold frame only. A \$30.00 value only \$14.95. 2 pairs for \$28.00.

To order send check or money order to U.S. Optics, Dept. 749, P.O. Box 14206, Atlanta, Georgia 30324. Credit card customers please fill in card # and Exp. date

QUANTITY	MODEL #	GOLD	SILVER	PRICE
	20P			
	30A	X		
	30D	X		

Add Postage, Handling, and Insurance
\$1.00 per pair

Total _____

Visa or Master Charge # _____ Exp. Date _____

Name _____

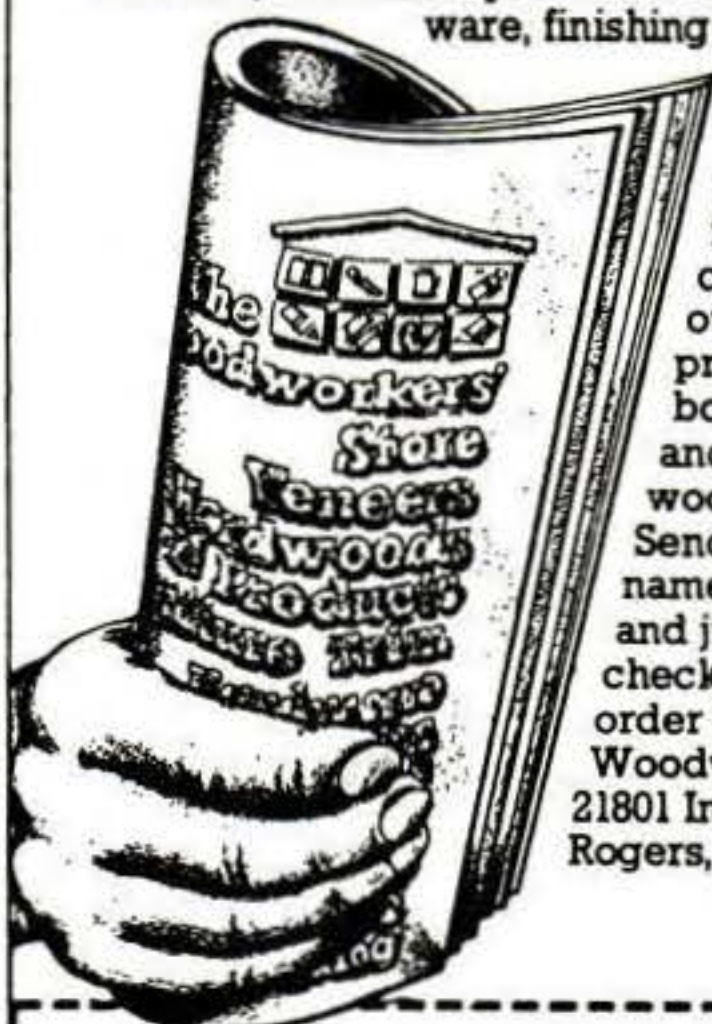
Address _____

City _____ State _____ Zip _____

FREE case with each pair.

Woodworkers, get your hands on our catalog.

You'll find such unique products as veneers and inlays, mouldings, fine hardwoods, furniture trim, and wood products. Plus tools, hardware, finishing supplies and how-to books.



Our beautifully illustrated catalog has over 3,000 products for both beginning and expert woodworkers. Send your name and address and just \$1.00 in check or money order to: The Woodworkers' Store, 21801 Industrial Blvd., Rogers, MN 55374.

Name: _____

Address: _____

City: _____ State: _____ Zip: _____



Dept. C506
21801 Industrial Blvd.
Rogers, MN 55374

What a Combination



© Traditional Living, Inc. 1981

The free warmth of
the sun combined with
the natural insulation of logs.

Four new passive solar designs provide today's energy conscious buyer with a home that is both handsome and affordable. Simple to construct, uncomplicated to live in and economical to operate.

Our colorful 40-page brochure illustrates more than 35 flexible designs. Send \$5 now for your beautiful design catalog, or telephone toll-free

800-451-4485.



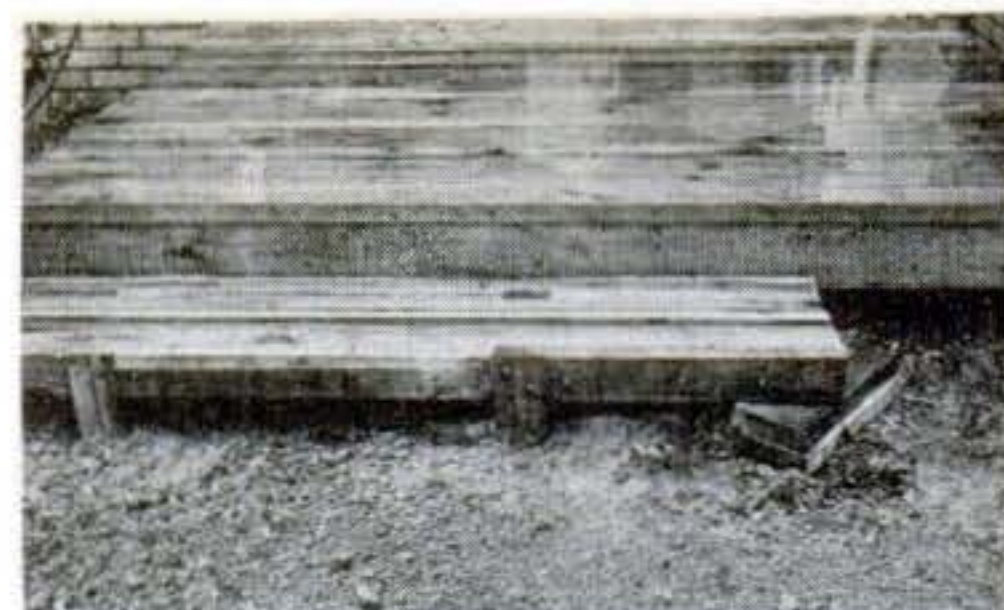
REAL LOG HOMES

® National Information Center
Dept. PSA, Box 202,
Hartland, Vermont 05048

The Log Home Leader
with 130 Dealers from Coast to Coast

Butcher-block construction

[Continued]



Butcher-block steps are built in the same way—but lower, and of 2×4, not 2×6.

bench legs that come in contact with the ground; redwood garden grade can be used elsewhere. See photos and table for construction details.

Butcher-block steps are not recommended for more than four risers. To fit landscaping and ground contours, the steps can be staggered or varied in length; the materials list covers the same three lengths as for the bench.

If connected to a deck, usually the top step can be nailed to the deck skirtboard. Step legs should be placed in one-foot-deep holes and—with the steps propped level—embedded in concrete.

Left natural, redwood weathers to an attractive driftwood gray. If you wish to apply a stain or bleach, let the wood weather for a month, then brush on two coats of semi-transparent oil-based deck stain diluted 50-50 with water repellent containing a mildewcide. (Should mildew ever form, scrub the wood with a detergent and rinse with liquid bleach and water.)

BUTCHER-BLOCK STEP—your choice of three lengths

Materials lists:
Legs—all 2×4's

Vertical drop	Steps	2×4's	Cut to
12 in.	One	(2) 10 ft.	(4) 18 in. (6) 14 1/2 in.
18 in.	Two	(2) 14 ft.	(2) 23 1/2 in. (6) 20 1/2 in.
24 in.	Three	(1) 10 ft. (2) 16 ft.	(4) 30 in. (6) 26 7/8 in.
30 in.	Four	(1) 12 ft. (2) 18 ft.	(4) 35 1/2 in. (6) 32 1/8 in.

Treads—all 2×4's (per tread)

Tread length	2×4's	Pieces cut to
4 ft.	(6) 8 ft.	(10) 4 ft.
6 ft.	(12) 6 ft.	(10) 6 ft. (4) 12 in.
8 ft.	(12) 8 ft.	(2) 40 1/2 in. (10) 8 ft. (4) 16 in. (2) 56 1/2 in.

DECK PLANS AVAILABLE

If you need help designing a deck for your backyard, there's a planning kit you can buy. The California Redwood Association (One Lombard St., San Francisco, Calif.) is offering a Redwood Design-A-Deck plans packet: a clever array of plans sheets and punch-out cardboard modules that help you prepare a custom deck. Created by Richard K. O'Grady, the kit is available from CRA for \$4.

Shoppers Showcase

A selection of products and services for Popular Science readers available direct by mail. Enjoy the fun and convenience of mail order shopping. Please order directly

from the advertiser. For advertising rates for this section, write Cathy Starrantino, Popular Science, 380 Madison Avenue, New York, N.Y. 10017.

GARAGE DOOR OPENERS

- Radio Controlled

- Buy Factory Direct and Save
- Thousands In Use • Free Brochure
- Easy Homeowner Installation
- Immediate Shipment by UPS or PP

HELMATE Equipment Co. Dept. PS-681, Baroda, MI 49101

DISCOUNT TRS-80® DEALER A301 COMPUTER SPECIALISTS



FREE
COMPUTER
CATALOG
UPON
REQUEST

\$ DISCOUNT \$ on TRS-80's

26-3001 4K Color.....\$353.00
26-1062 16K III.....865.00
24-4002 64K 1 DRIVE.....3440.00

1-800-841-0860 TOLL FREE

MICRO MANAGEMENT SYSTEMS, INC.

Downtown Plaza Shopping Center, 115 C. Second Av., S.W.
Calro, Georgia 31728, (912)377-7120 Ga. Phone No.

The New Look from Elite

The ultimate in a GT Sports Car Kit for a VW chassis. Send \$3.00 Color Brochure, and Prices or \$29.95 for Full Pack. (Refundable with Kit Purchase). Color Brochure, Prices, Assembly Manual, Color Chart, Free Flight Information.

ELITE ENTERPRISES, INC. PS-6-81
690 E. Third St. Coakato, MN 55321
To order \$29.95 Full Pack call Toll Free 1-800-325-0888.
Refundable with Kit Purchase. Major Credit Cards Accepted.
Fly to Mpls./St. Paul FREE* to personally order your LASER 917
* This information included in Full Pack only

\$1.50 a gallon vs. 1/10¢ a mile



Electrify Your Bike!

Travel with PEDALPOWER®, low-cost electric drive for your bike or adult trike. Just 10¢ worth of electricity gives you 100 miles of effortless riding. Save on gas, taxis, stop begging

rides from friends. Perfect for shopping, visiting, commuting, just plain fun!

PEDALPOWER fits men's, women's, children's bikes and adult trikes, installs in minutes without special tools. Safe single-lever handlebar control, instant start without pedaling, up to a 40-mile range on a single charge. Satisfaction guaranteed. Send coupon for free catalog showing PEDALPOWER motors, our unique Take-Apart bikes, and ready-to-ride adult trikes. Get PEDALPOWER and laugh at gas prices!

SEND COUPON FOR FREE CATALOG

PEDALPOWER®

5287 Mantua Blvd.,
Sewell, N.J. 08080

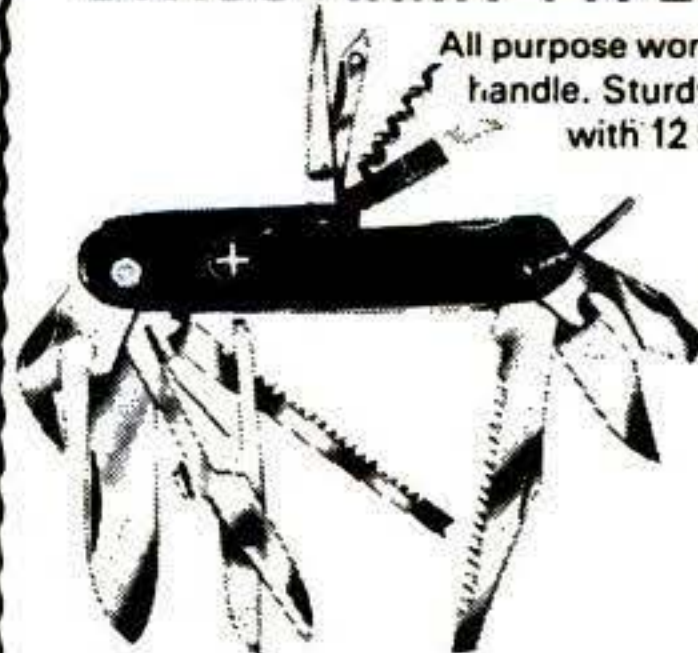
Rush me my FREE PEDALPOWER catalog by first-class mail.

Name _____

Street _____

City/State/Zip _____

SWISS ARMY TYPE KNIFE



All purpose wonder knife. Red handle. Sturdy survival knife with 12 Stainless Steel

Blades. perfect for fishing, camping, work and play
Guaranteed

4.50 ea.

Add 50¢

Post &

Handl

Westbury Sales P.O. Box 434, 373 Maple Ave.
Westbury, N.Y. 11590 Dept. E-6-PS

FREE COLOR CATALOG



Build Your Own
Grandfather Clock
Prices Starting Under

\$250

(including movement and dial)

- Do-it-yourself case kit, parts pre-cut
- Finished clocks
- Solid 3/4" hardwoods: black walnut, cherry, oak
- Heirloom quality
- Factory direct prices
- Solid brass West German chiming movements
- Money back guarantee
- Prompt shipment

MASTERCARD and
VISA ACCEPTED



EMPEROR® CLOCK COMPANY

WORLD'S LARGEST MANUFACTURER
OF GRANDFATHER CLOCKS
Dept. 826 Emperor Industrial Park
Fairhope, Alabama 36532

WEEDHOPPER - The Ultimate Fun Flying Machine.

Build your own airplane in 40 hrs and fly off to adventure without a pilot's license.



Complete kit goes together with hand tools.

Will carry 220-lb pilot up to 50 mph. Price: \$3,395. Send \$5 for information.

Weedhopper Of Utah • Box 2253-C • Ogden, UT 84404

SUPER-STRENGTH FIBERGLASS REPAIRS

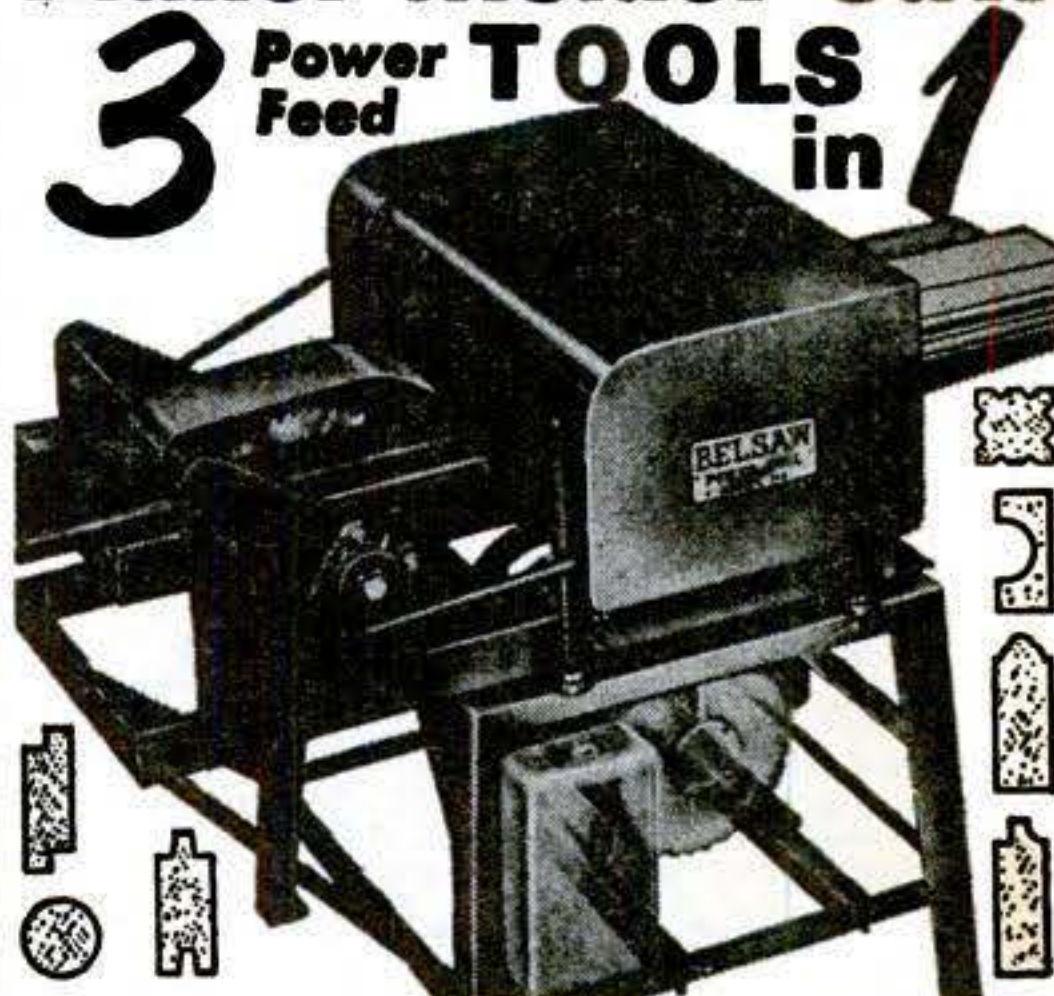


SAVE MONEY AND REPLACE-
MENT COSTS WITH EASY-TO-
USE SUPER-ISO RESIN. Repair
and waterproof fiberglass boats,
bathtubs and shower stalls.

Repair auto dents, gouges. Many other home and auto uses. A non-sag polyester resin with super-bonding strength! Exceptional coverage and "wetting" ability. Use with fiberglass cloth. ORDER #5701 Pint \$6.59; #5702 Quart \$9.39; #5703 Gallon \$30.49. #5831 38" x 1 yd. cloth \$5.89; #5832 38" x 3 yds. cloth \$13.49. Send check with order. Prepaid shipment. WRITE FOR FREE CATALOG

BOAT ARMOR MARINE PRODUCTS 1 W. Water, St. Paul, MN 55107

Planer Molder Saw



Now you can use this ONE power-feed shop to turn rough lumber into moldings, trim, flooring, furniture —ALL popular patterns. RIP-PLANE-MOLD . . . separately or all at once with a single motor. Low Cost . . . You can own this power tool for only \$50 down.

30-Day FREE Trial! SEND FOR
NO OBLIGATION—NO SALESMAN WILL CALL
RUSH COUPON BELSAW POWER TOOLS CO.
922H Field Bldg.
Kansas City, Mo. 64111

BELSAW POWER TOOLS
922H Field Bldg., Kansas City, Mo. 64111

☐ **YES** Please send me complete facts about
PLANER—MOLDER—SAW and
details about 30-day trial offer.

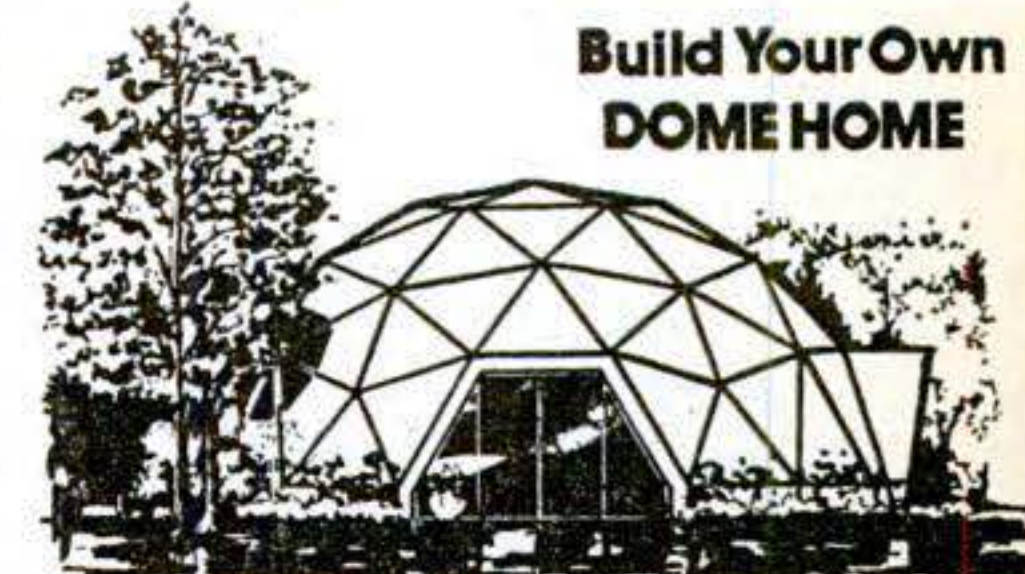
Name _____

Address _____

City _____

State _____ Zip _____

Build Your Own DOME HOME



Cut 6" thick polystyrene panels, connect them to form a dome, apply steel mesh and 2" cement. You can build this beautiful dome, 33' diameter, 17' high for appr. \$1900. Use the spacious, richly insulated, super energy saving dome for cottage or permanent home. Let us tell you how in our book entitled: "BUILD YOUR OWN GEODESIC DOME" describing various size domes. Send \$4.00 to:

KEY DOME ENGINEERING Dept. PS-6
P. O. Box 430253, South Miami, Florida 33143

Free!

Edmund Scientific Catalog



**OUR
40th
YEAR!**

Astronomy, Microscopy, Biofeedback, Weather, Alternate Energy, Binoculars, Optics, Magnets, Magnifiers, Tools, Unique Lighting, Lab Equipment, and much more. Over 4,000 unique and fascinating products. Send for our **FREE** 112-page, colorful 1981 Edmund Scientific Catalog... Today!

Rush me your free catalog!

Name _____

Address _____

City _____

State _____

Zip _____

Clip And Mail Coupon Today To:

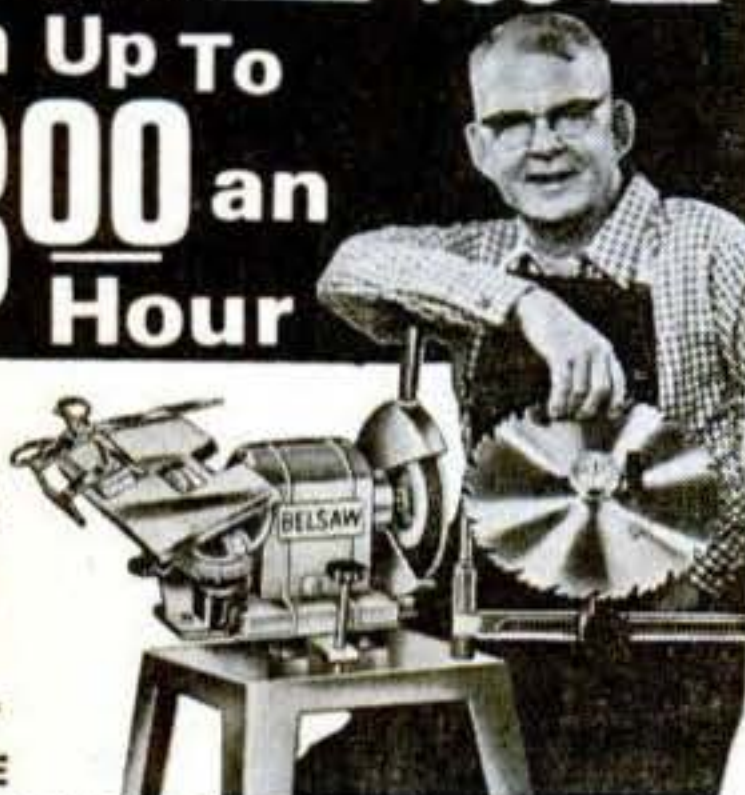
Edmund Scientific Co., Dept. 3016 N-12
Edscorp Bldg., Barrington, N.J. 08007

No. 226 ©1981 Edmund Scientific Co.

Let Belsaw prove **YOU** can

**Earn Up To
\$800 an
Hour**

**In
YOUR
OWN
SPARE
TIME or
FULLTIME**



SHARPENING BUSINESS!

**On our
30-DAY
FREE
TRIAL
OFFER**

You risk nothing by accepting this offer to see how easily you can turn your spare time into big Cash Profits with your own Complete Sharpening Shop. No selling... no previous experience needed. Our famous Sharp-All and show-how instruction set you up to make \$200, \$500, \$700 a month CASH sharpening Saws, Knives, Scissors, Lawnmowers, Shop and Garden Tools... all cutting edges.



FREE BOOK!
Gives Full Details

Send for all the facts!
Our Free Book tells how to start a profitable, lifetime home sharpening business, how we help you grow, how we'll finance you.

Send for FREE details—mail coupon below or postcard TODAY!
BELSAW SHARP-ALL CO., 702H Field Bldg. Kansas City, Mo. 64111

No Obligation... No Salesman Will Call

YES, ☐ BELSAW, 702H Field Bldg., Kansas City, Mo. 64111
please send me the **FREE BOOK** that gives full details.

Name _____ Please Print _____

Address _____

City-State _____ Zip _____

130 | POPULAR SCIENCE

"If I had the tools and materials to build my own bike from scratch, I don't think I could build one any better."

John Jurenka,
Santa Monica, CA

Save assembly costs when you build your rugged work or play machine (in just 6 — 12 hours) with an easy kit from Carl Heald, Inc. Choose from 10 bike, 8 tryke models; engines from 5 to 16 H.P. All have Comet torque converters (no shifting); full suspension (smooth ride); tubular steel frames (shrugs off rough going). Optional electric start, lights for licensing, other accessories.



**NEW VT-1012
(10-hp)
SUPER
BRONC**
shown with
accessories

Special Offer
— One FREE
accessory
with bike or
tryke order!

Carl Heald, Inc.
Dept. PS-86, P.O. Box 1148
Benton Harbor, MI 49022

Write today for free brochure

Build this beautiful Dome Home by yourself!



Enjoy super-low energy bills and house payments

Save up to 50% on utilities, and up to 60% on building costs. Beautiful Monterey Domes geodesic homes are extremely energy-efficient, unbelievably strong, earthquake resistant, and easy to assemble. No special tools or skills necessary. Our unique, patented building system makes home construction a reality for the novice.

Monterey Domes pre-cut, color-coded shell packages start at \$3995. Models up to 3,500 sq. ft.

Send for our color Catalog & Plan Book — 90 fact-filled pages of exciting, affordable homes. Sales representatives available for all 50 States.

Write today!

☐ Rush me your 90 page CATALOG & PLANS BOOK. Enclosed is \$6.00, postage included.
☐ Also send your ASSEMBLY MANUAL for an add'l \$5.00.

NAME _____

ADDRESS _____

CITY, STATE, ZIP _____

Mail To: **MONTEREY DOMES**
1855 Iowa, Dept. AR-6
Riverside, Calif. 92517



**INSTANT
GAS SAVER!
JUST ADD A BIKE AND
GET 200 MPG AT SPEEDS
UP TO 35 MPH**



**FACTORY DIRECT \$179.95
SALE**

Reg. \$199.95

**Ride over 3,000 miles
FREE with special rebate offer**

The air-cooled, 1.3 HP, 34 cc, 2-cycle BUMBLE-BIKE MOTOR installs easily with just two bolts. Motorcycle-type clutch and throttle controls. Does not interfere with normal pedaling. Satisfaction guaranteed.

**WRITE FOR FREE BROCHURE
AND SPECIAL FACTORY REBATE OFFER**

Bumble-Bike®
Dept. 8-6, P.O. Box 1116
Havana, FL 32333 U.S. Patent Pending

PROTECT YOUR CAR INVESTMENT

New
Scientific Product that
Electronically Monitors
your Oil and Determines
when it is to be changed.
This Solid State Device is
100X more accurate than
the unaided eye.

Cannot be used
with Graphite or
Diesel Oils

**29.95 for complete unit
3.95 for installation kit**

Please include 1.50 for Postage & Handling

Fits all cars and is easy to install
Unit is fully guaranteed

Order From:

INNOVATIVE ELECTRONICS CORPORATION
Bearhead Road, Medford, New Jersey
Phone: (609) 654-2786 08055
New Jersey Residents include 5% Sales Tax
Signature Required for Credit Card Users
Allow 6-8 weeks for delivery



STICK 'EM UP, AMERICA!

Our headline might be funny except that it describes our energy situation so well. Our patent file searches prove we can break our slavery to the energy industries. Proof is in our dynamite new book entitled **"FREE ENERGY: A COLLECTION OF U.S. PATENTS"**. (NOT solar or wind energy). For full details, send your name, address, zip code:

THE FREE ENERGY PRESS Dept. PS-6
P.O. Box 22469, Robbinsdale, Minnesota 55422

CHECK IT OUT!

There are more opportunities, products and services offered in the "Classified Opportunity Mart," immediately following this section. You may find just what you've been looking for.

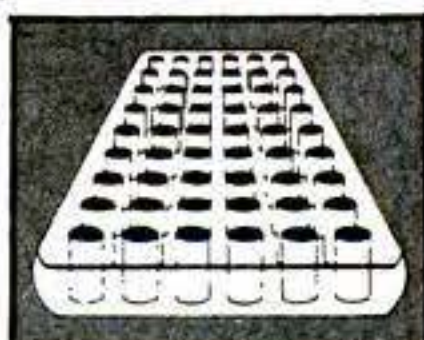


The lightweight Air Bed offers a revolutionary sleeping experience. Gently, but firmly supports you with 100% air. Features air coil construction with multiple controlled air chambers that hold your body evenly and independently. Turns any room into a guest room. The ideal portable bed for holiday and vacation visitors...and it stores easily. Take it camping, in your van, on your boat, in your summer home; sunbathe and float on it!

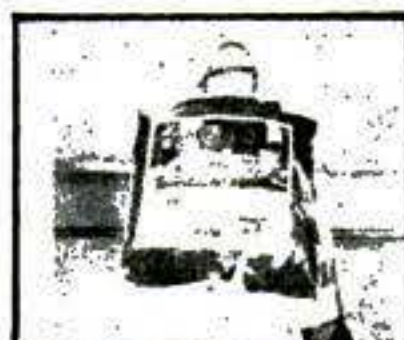
Available in twin, double, queen and king sizes. Inflates in minutes with most air pumps or cannister vacuum. High-power air pump available—optional.) Made of sturdy gauge poly vinyl, cleans with soap and water. Repair kit and pump adapter included.

Don't be misled by imitations. Insist on the original, velveteen **The Air Bed**. 10-day Free Trial. If not satisfied, return it within 10 days for refund. Order now!

Contemporary Marketing, Inc.



Air Coil Construction



Stores Easily on Shelf

Please send me the following AIR BED(S):

☐ Twin Size (Item 2339)	\$49.95
☐ Double Size (Item 2354)	\$69.95
☐ Queen Size (Item 2360)	\$79.95
☐ King Size (Item 2374)	\$99.95

Add \$6.95 per bed for shipping and insurance.

☐ AC Air Pump (Item 0004)	\$29.95
☐ DC Pump-12 volts (Item 0005)	\$29.95

Illinois Residents include 5 1/4 % sales tax.

☐ Check/M.O. Enclosed ☐ Charge My Credit Card:

☐ Master Charge	☐ American Express	☐ Carte
☐ Visa	☐ Diners Club	☐ Blanche

Card No. _____ Exp. Date _____

Name _____

Address _____

City _____

State _____ Zip _____

Signature _____

Contemporary Marketing, Inc.
790 Maple Lane, Bensenville, IL 60106
Dept. PSME-152 © CMI1981251

NOW SAVE 135.00

on a famous TROY-BILT Tiller!



Just ONE HAND!

"Off-Season" Savings now in effect! Right now is the best time ever to learn about the amazing TROY-BILT Roto Tiller-Power Composter...the "break-through" machine that's allowing anyone —of any age—with any soil—to easily have a fabulously fertile, productive garden! For free complete details, prices, write today to:

TROY-BILT 102nd St. & 9th Ave., Troy, NY 12180.
© 1981 Garden Way

TROY-BILT® Roto Tiller-Power Composters
Dept. A810
102nd St. & 9th Ave., Troy, N.Y. 12180

Please send the whole wonderful story of TROY-BILT® Roto Tillers including prices and OFF-SEASON-SAVINGS now in effect for a limited time.
(Please Print Clearly)

Mr. _____
Mrs. _____
Ms. _____

Address _____

City _____

State _____ Zip _____

DOUBLE-WALL INSULATED SOLAR GREENHOUSES

ALL STYLES & WINDOW UNITS FROM JUST... **\$399**

SOLAR QUICK-MOUNT PANELS FOR SKYLIGHTS, WALLS, ROOFS

AS LOW AS JUST... **\$315** SQ. FT.

SOLAR STRUCTURES & ACCESSORIES THAT HELP HEAT YOUR HOME AND QUALIFIES YOU FOR A

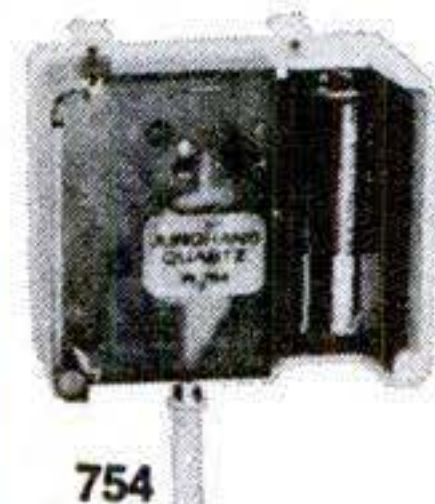
40% TAX CREDIT!

COLOR BROCHURE \$1, SENT FIRST CLASS

VEGETABLE FACTORY, INC.
P.O. Box 2235, Dept. A-279
New York, NY 10163
Or Call: (212) 867-0113

QUARTZ CLOCK MOVEMENTS

Quality Clock Movements From West Germany's Famous Junghans Clockmakers.



Model 754 Junghans Quartz Pendulum

- One-minute-per-year-accuracy
- Battery operated. Runs up to 3 years on one C cell
- Realistic pendulum motion with slightly audible ticking sound. Standard 16 1/2" rod length is easily altered to desired size.
- Minimum moving parts
- Dimensions: Height 2.5" Width 2.75" Depth 1.5" Shaft Length .85"

1-2 pc \$14.95 ea.	3-9 pc \$13.95 ea.	10-24 pc \$12.95 ea.
25-49 \$11.95 ea.	50-99 \$10.95 ea.	100+ \$9.95 ea.

SELVA BOREL

347 13TH ST., P.O. BOX 796 W
OAKLAND, CALIFORNIA 94604
(415) 832-0355



Model 756 Junghans Quartz

- One minute-per-year-accuracy
- Battery operated. Runs up to 4 years on one C cell
- Long life, stability and accuracy
- 2 year guarantee
- Dimensions: Height 3.19" Width 2.32" Depth 1.06" Shaft Length .85"

1-2 pc \$7.75 ea.	3-9 pc \$7.00 ea.	10-24 pc \$6.00 ea.
25-49 \$5.75 ea.	50-99 \$5.50 ea.	
100+ \$5.25 ea.		

SELVA BOREL, 347 13TH ST. P.O. BOX 796 W OAKLAND, CALIF. 94604

NAME _____ CITY _____

VISA ☐ MASTERCARD ☐ ADDRESS _____ STATE _____ ZIP _____

SIGNATURE _____ CARD NO. _____

QUANTITY: _____ at \$ _____ TOTAL \$ _____

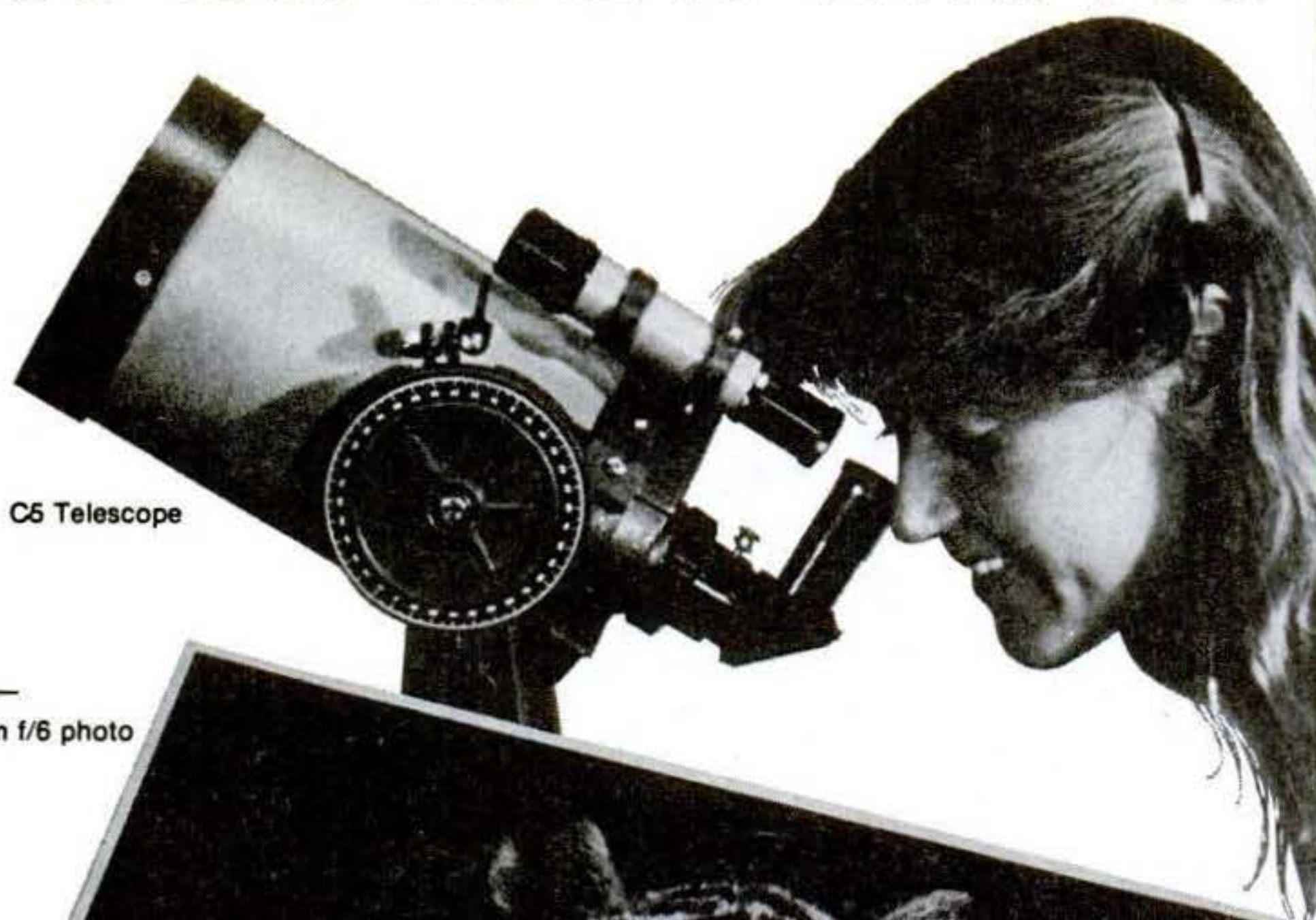
(CALIFORNIA RESIDENTS ADD 6% SALES TAX)

SHIPPING: ADD \$2.00

ENCLOSED \$ _____

FREE WITH ORDER: 1981 CATALOG \$2.00

YOU CAN TAKE IT WITH YOU



C5 Telescope

Tiger —
750mm f/6 photo



C8 Telescope with
35mm camera attached

35mm photography
is as easy as adding
your camera for exciting
close-ups of your favorite subjects.



C8 one-hand
portability

CELESTRON telescopes and telephoto lenses are compact and lightweight. The modern Celestron design means you can take it anywhere and have it set up and operating in minutes. Under clear, dark, steady skies, the amount of detail seen through Celestron telescopes borders on the fabulous. As a daytime telescope, see or photograph ships, planes, wildlife and people at incredible distances with complete clarity. Apertures available from 3-1/2" to 14" priced from \$295.00. Celestron also has a full line of binoculars of astronomical quality.

Send \$2.00 for 32-page full color catalog on how to select and use a Celestron telescope or telephoto lens.

(DEALER INQUIRIES INVITED)

Celestron

CELESTRON INTERNATIONAL, 2835 Columbia St., Box 3578-PS Torrance, CA 90503, U.S.A.
(213) 328-9560

You and a friend can build this Lincoln Log home in ten days.



We give you everything you need, down to the last nail. Dollar for dollar, the basic Lincoln Logs Home Package is the most complete in the industry, designed and engineered for quick, easy construction. We supply all blueprints, plans and an instruction manual that gives you the "How To" in simple language with easy-to-follow illustrations. And your local Lincoln Logs Distributor will give you 4 hours of on-site instruction to answer any questions you might have. Lincoln Logs will even assemble a package based on your floor plan or architectural design . . . AT NO EXTRA COST. Send just \$5 for your Lincoln Logs Home Planning Kit with plans for 17 different log homes.

(Dealer inquiries invited)



THE ORIGINAL
Lincoln Logs Ltd.

6 Spring Mill Road, Chestertown, New York 12817
1-518-494-2426 © 1980 Lincoln Logs, Ltd.

ENGELHARD SILVER BARS

(.999+ Fine)

Available in Investor Lots
(Min. 100-ozs.)

1x 100-oz Bar —
Comex Spot + \$1.00 per oz.

10x 10-oz Bar —
Comex Spot + \$1.50 per oz.

100x 1-oz Bar —
Comex Spot + \$1.60 per oz.

Shipping — \$18.00 per 100-ozs.
No Additional Charges or Commissions
No Sales Tax on Out-of-State Shipments

Telephone all orders to lock-in rates. MTB
must receive funds within 3 business days.

Call (800) 223-5818, Ext. 95

TOLL (800) 223-0998, Ext. 95

FREE (800) 221-9830, Ext. 95

Write for free illustrated brochure.

Rockefeller Center 59 West 49th St. N.Y., N.Y. 10112 (212) 974-3455	One World Trade Center Concourse Level #151 N.Y., N.Y. 10048 (212) 775-1440
--	--

The largest supplier of gold and silver bars
to the Collector/Investor for over 27 years.



**MANFRA,
TORDELLA &
BROOKES, INC.**

AWARDED THREE U.S. PATENTS!

SUPERLADDER

—THE MOST VERSATILE LADDER IN THE WORLD!
OVER A HALF-MILLION SOLD!



SUPER-STRONG!

Scaffold position easily supports two working men —yet so light you can take it everywhere!

NOTHING TO ASSEMBLE!

Compact and Complete... Patented locking system makes Superladder do anything you want:

extension ladder • sawhorse • double ladder • inclined plane

INDOORS OR OUTDOORS...

Up Stairways or down Stairwells...for every kind of repair work:

carpentry • painting • cladding • shingling

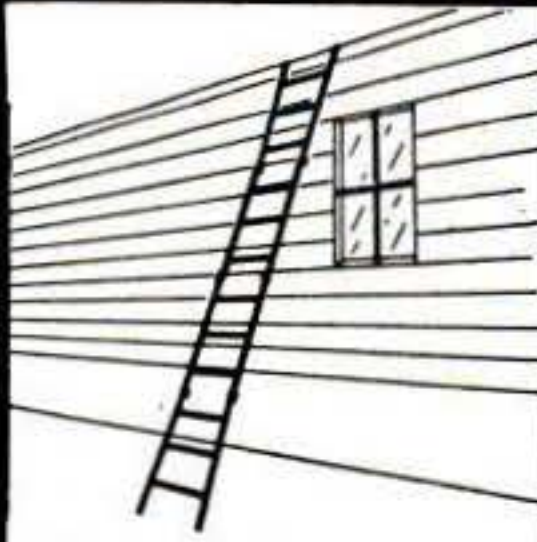
PERFECT FOR: home and garden • do it yourselfers • carpenters • painters • plumbers • farmers

LASTS A LIFETIME!

—The only ladder you will ever have to buy!



STEP LADDER



STRAIGHT LADDER



HOUSE LADDER



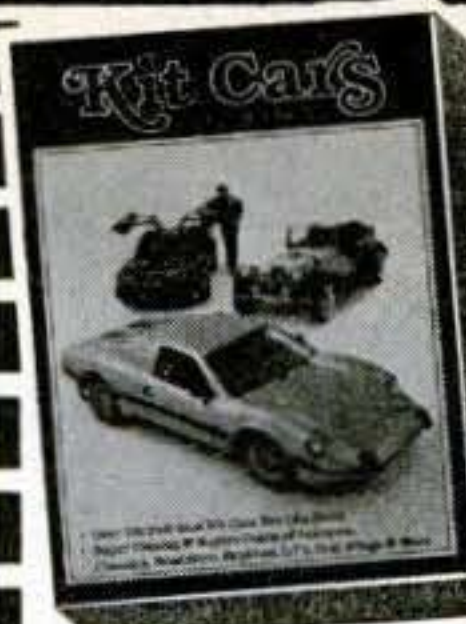
TAKE-ALONG LADDER

CLIP AND MAIL TO
ADW. Dept. B. P.O. Box 21894
Milwaukee, Wisconsin 53221

SEND NOW FOR FREE COLOR BROCHURE!

Name _____
Address _____
City _____
State _____ Zip _____

130 FULL SIZE SPORTS CARS You Can Build from Kits



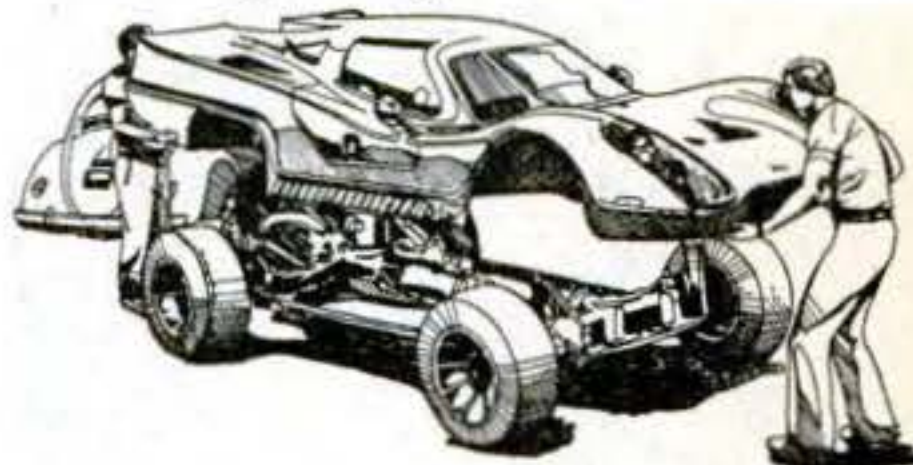
Giant Buyers Guide

160 Pages, 500 Photos

Giant Kit Car Buyers Guide reveals 130 full-size sports and replicas you can build from kits. Most sell for a fraction of their completed price and nearly all are easy to assemble at home. See and compare all the latest kit cars and manufacturers • Complete Photos • Articles • Specs • Tech Data

• Everything from 40 mpg roadsters to sizzling V8s. (Also available Kit Car Monthly Newsletter, features hundreds of used kit car bargains, sixteen value-packed pages each month.)

★ 14 Day Money Back Guarantee ★



AUTO LOGIC, INC.

P.O. Box 2073
Department PS61
Wilmington, DE 19899

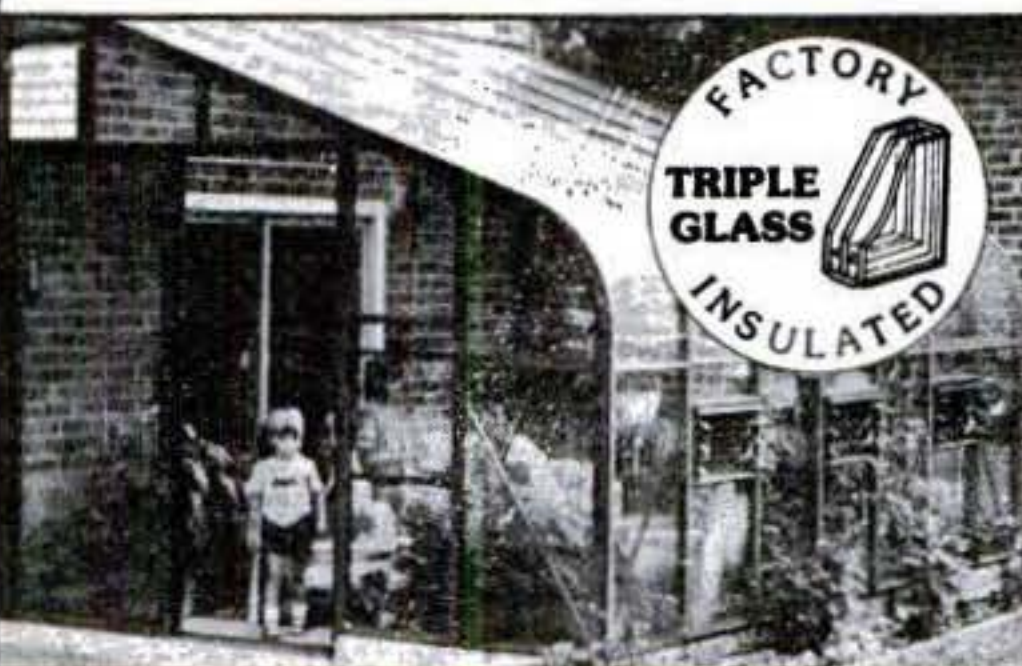
Mail Kit Car Buyers Guide

☐ \$ 9 (3rd Class—US only)
☐ \$12 (1st Class—US only)
☐ \$15 (Foreign—US funds)
☐ Kit Car Monthly \$11

Name _____
Address _____
City/State/Zip _____

☐ Master Charge ☐ Visa Exp. Date _____
Order TOLL-FREE Day or Night
Master Charge or Visa REQUIRED!
(800) 331-1000, Operator 666
(918) 664-8300, in Okla., call collect

NEW SUNROOM

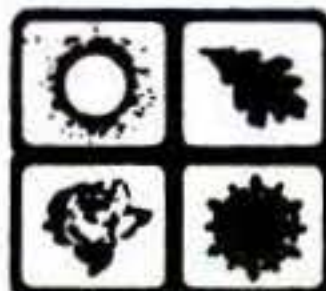


and PASSIVE SOLAR GREENHOUSE

- ☐ New System 3 - "Brookhaven" model
- ☐ Factory insulated triple glazing
- ☐ G.E. Lexan® Shatterproof Panels
- ☐ 40% Tax Credit & State Credits
- ☐ Lean-To, Free Stdg. & Window units
- ☐ Curved Eave, Bronze Tone Finish

COLOR CATALOG and TAX CREDIT GUIDE: Enclose \$1. for our catalog and price list, plus our guide to the latest federal and state passive solar tax credits and qualifications. All kits shipped Freight Prepaid.

SAMPLE WINDOW KIT: Enclose \$5. for catalog and tax guide above, plus actual samples of greenhouse alum. frames, G.E. Lexan® glazing, assembly manual and heating guide.



FOUR SEASONS GREENHOUSES

910 Route 110, Dept. PS-106
Farmingdale, N.Y. 11735
Phone: (516) 694-4400

Div. Four Seasons Solar Products, Corp.
(Custom Built to Standard Sizes)

BEST BUY!

EASY-TO-ASSEMBLE KIT

ONLY \$395 F.O.B.

For 3'6" diam. Other diam. from 4' to 7' at comparable savings. All diam. adjust to floor-to-floor hts. of 8'1/2" to 9'6".



ATTENTION
WEST COAST
RESIDENTS:
Our Los Angeles
Warehouse/Showroom
will open
2nd quarter 1981.

©The Iron Shop 1977

People who've looked everywhere tell us there isn't another spiral stair around that touches our combination of price and quality of materials and workmanship. We believe it!

CALL OR WRITE FOR FREE BROCHURE:

To: The Iron Shop, Dept. 19S Box 128, 400 Reed Road,
Broomall, Pa 19008 Our Tel: (215) 544-7100.

Name _____
Street _____
City _____ State _____ Zip _____
We accept MasterCard and VISA.

THE IRON SHOP
MANUFACTURERS

Make up to
\$12⁵⁰ an hour

Start your own
money making business!

Hundreds of Belsaw trained men have succeeded in this fascinating and highly profitable field...

YOU Can Do It Too!

BE A LOCKSMITH

Never before have money-making opportunities been so great for qualified locksmiths. Now lucrative regular lock and key business has multiplied a thousandfold as millions seek more protection against zooming crime. Yet there's only one locksmith for every 17,000 people!

Train FAST at Home—Collect CASH PROFITS Right Away. You're "in business" ready to earn up to \$12.50 an hour a few days after you begin Belsaw's shortcut training. Take advantage of today's unprecedented opportunities in locksmithing for year-round EXTRA INCOME in spare-time—or fulltime in a high-profit business of your own. Hundreds we've trained have done it. So can YOU! All tools plus professional Key Machine given you with course. These plus practice materials and equipment, plus simple, illustrated lessons, plus expert supervision, plus business-building guidance will enable you to KEEP THE MONEY COMING IN! Ideal for retirement—good jobs too. SEND FOR EXCITING FACTS—No Obligation!

ALL SPECIAL TOOLS AND EQUIPMENT INCLUDED!

PRO KEY

MACHINE

YOURS

TO KEEP!

This Pro Key Machine can also add up to \$200 a month to your income... and it won't cost you a penny extra with your training. Find out all about it!

RUSH COUPON!



Send for your RUSH COUPON! copy today!

Accredited Member National Home Study Council

BELSAW INSTITUTE
112H Field Bldg.
Kansas City, MO. 64111

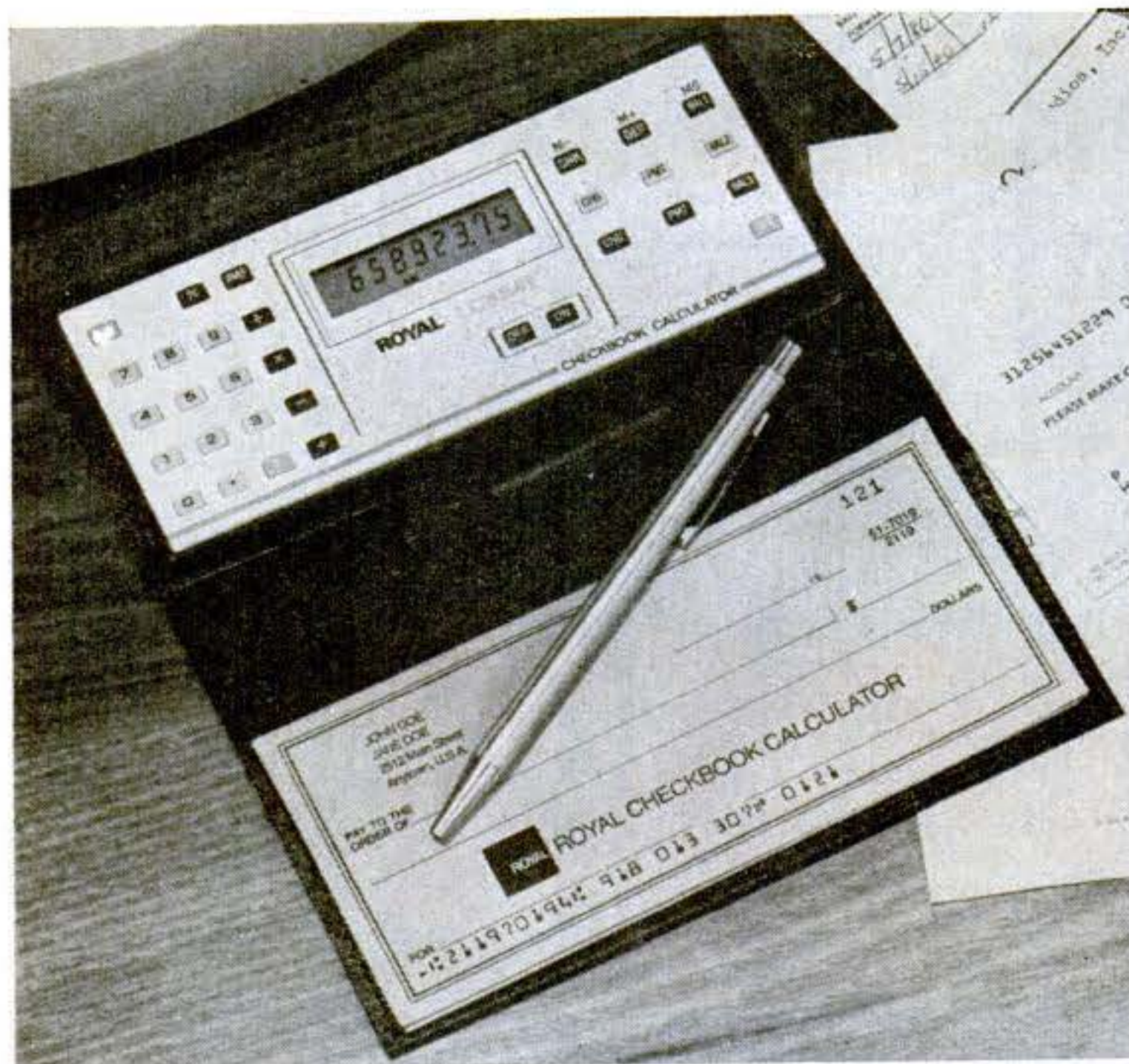
There is NO OBLIGATION and NO SALESMAN Will Call—ever!

FREE! BELSAW INSTITUTE

112H Field Bldg., Kansas City, Mo. 64111
Please rush FREE Book "Keys to your Future."

NAME _____
ADDRESS _____
CITY-STATE-ZIP _____

New Royal Check-book Calculator Your Personal Banker and Budget Director



Handles all calculations; tracks your checking account, your savings account, even monitors your budget

**AND KEEPS IT IN MEMORY—
READY FOR INSTANT RETRIEVAL**

Leave it to Royal to keep you up-to-the-minute on all your banking, your charge accounts, your personal accounting.

And to give you all this in a handy, 8-digit calculator that you can use for all personal and business calculations: Addition, subtraction, multiplication, percentage additions and discounts, etc. The whole works, including floating decimal.

But where it really earns its keep and small cost—ten times over—is giving you an exact, immediate report on your financial condition. Every second of every day.

Just punch in your checking account transactions (deposits and checks drawn) as you make them. It keeps them all in its ever-vigilant 3-memory capacity.

Want your checking account balance? One key gives it to you. Get the same smart service on your savings account—exact amount you have in it. Always.

And a step beyond this: It gives you a complete record of all your charge account transactions—to let you know the total amount of charges, less payments made.

If you'd like your exact net financial status, (total dollars and cents in banks, less all outstanding charges) get that, too. At the touch of a button. All this, mind you, held ready for your instant retrieval in three independent memory modes. Which you can clear and re-set any time.

Extra advantages: Automatic constant for chain calculations; automatic shut-off after 7 minutes of non-use; operates approx. 1,000 hours on set of easily replaced batteries (included).

This incredible combination of accountant, banker and budget controller is beautiful, small and slim. And it's fitted into a deluxe leather-like check book wallet that also holds your credit cards, check book (and cash, if you wish).

Measures only 6 3/4" across; 7 1/4" (with case open); 3 1/4" with case folded, and about 1/4" thin. Case and all. Calculator itself is brushed gold. Snaps in and out of case. Measures just 6" x 2 1/4" x less than 1/8" thin.

BONUS: With it, you get a deluxe retractable pen, which matches brushed gold of calculator and fits neatly into wallet.

All this—calculator, wallet check-book case, and pen—only **\$34.95**, plus \$2 shipping and handling. Fits neatly into pocket. Tucks into purse.

Guaranteed to please you and provide all these services—flawlessly—or you may return it any time within 30 days for a prompt refund or credit.

To order, send check or money order to address below—or to charge to Visa, MasterCard, Am. Exp. or Diners Club:

CALL TOLL FREE—ANY TIME

1-800-331-1750

(ask for operator 403)

(In Okla., call 1-800-722-3600)

**TMM CHECKBOOK CALCULATOR, Dept. PS061
Box 9569, Church St. Sta., New York, N.Y. 10249**

(Residents of AZ, CA, CO, FL, IL, NY, PA, VA, VT, WI add applicable sales tax to pay't of your order)

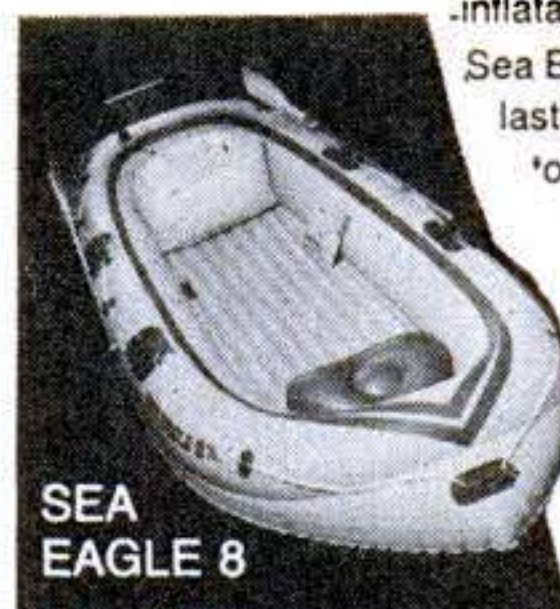
The Quality Alternative to High-Cost Inflatables

Why pay \$600. or more for an inflatable boat?

Sea Eagles pack small, last years and cost \$100

to \$220. Canoes, dinghies and motormount boats. Write for **FREE** brochure.

Sea Eagle,
Dept. PS-6
St. James, NY 11780
phone 516-724-8900



LOG SPLITTER PARTS 2-STAGE CAST IRON GEAR PUMP

Supplies 10 1/2 GPM at 650 PSI until more pressure is needed. Then kicks down to lower GPM and up to 2500 PSI. Right hand rotation (direct couple), 3600 max. RPM, Wt. 12 lbs. Will ship anywhere in U.S. for \$3 FRT.

4-WAY CONTROL VALVES
Built-in relief valve. 3/4" in-out ports, 1/2" cylinder ports. Item E102V **\$40.00**
With pressure sensitive detent, on return stroke you don't have to hold handle. Item E102VO **\$59**

Double-Acting Cylinders

3 1/2" bore, 18" stroke, 1 1/2" rod, 43 lbs. **\$93**
3 1/2" x 24" stroke, 1 1/2" rod, 52 lbs. **\$106**
4 x 24 x 1 3/4 Rod. **\$138**
4 x 24 x 2" rod H.D. **\$149**
5 x 30 x 2" rod. **\$228**

NEW ENGINES

5 HP Tecumseh recoil start 3/4" shaft ... **\$115**
Briggs **\$118**
8 HP Tecumseh, recoil start, 1" shaft ... **\$167**
10 HP Tecumseh, recoil start, 1" shaft ... **\$182**
Electric start. **\$229**
10 HP El. Start **\$229**

Send \$1.00 for catalog on Valves, Cylinders, Hoses, Frames, Tanks, Wedges, Slides, Wheels or \$5.00 for Catalog & Splitter Design & Fact book

NORTHERN HYDRAULICS

1137 Riverwood Drive, Burnsville,
MN 55337. Hours are 9-6
(612)894-8310 PS6

SOUND WITHOUT SPEAKERS

Go in business full or part time selling amazing development that eliminates need for speakers.

The 8 oz. **ACOUSTIC 2000** causes entire walls, ceilings, autos, boats, or practically anything else to gently vibrate and actually produce stereo sound. Easily connects to stereos, radios, phonos just like a speaker. **SAMPLES \$29.95 ea.** Use two for stereo. Free literature on request

RELIANCE ELECTRIC MANUFACTURING CO. INC.

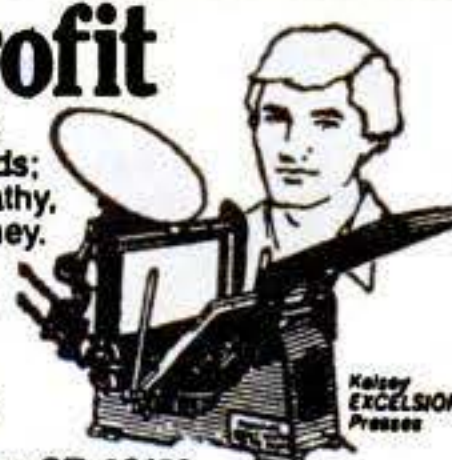
Rte. 2, Maitland, FL 32751 Tel. 305-862-3038

Print For Profit

Cards; stationery; envelopes; advertising; labels; tickets; QSL cards; announcements; greeting, sympathy, prayer cards; tags, etc. Save money. **Own a Printing Business.**

We supply everything direct from factory. Easy instructions. Also raised printing like engraving. Have home shop. Add to income. Send 25¢ for catalog.

Kelsey Presses, 81-CF, Meriden, CT 06450



TABCO STEEL BODY PARTS FOR IMPORTED CARS

Over 700 fenders, doorskins, rocker panels, rear quarter sections and other replacement panels simplify rust or collision repair on most import cars. Discount prices. Available in Canada. Send \$2.00 for illustrated catalog. **DEALER INQUIRIES INVITED.**

P.O. Box 39474 • Dept. PS • Cleveland, Ohio 44139
(216) 248-5151

solar components CATALOG



SOLAR HEATING PRODUCTS CATALOG

Everything for ACTIVE and PASSIVE solar heating, including Sun-Lite® Glazing and Thermal Storage Systems, plus hard-to-find energy savers. 68 pages, 15 sections. \$3.00 ppd.

SOLAR COMPONENTS CORPORATION

Dept. P P.O. Box 237
Manchester, NH 03105



Portable Steam Cleaner

Steam in 60 seconds
CLEAN:
Engines, Air Filters, Lawn Mowers. 3 year guarantee on fire box, coils. Uses liquid soap, propane fired. Weight 120 lbs. Auxiliary pump required on low water pressure.

WEDCO MFG. INC., Dept. S-10
Scott Lane • Box D, Jackson, WY. 83001

MOLDS

for making
Ornamental Concrete
Items...



Book about Aluminum
Molds with prices and
production trade secrets
direct from world's larg-
est mold manufacturer.

SEND \$5.00

CONCRETE MACHINERY COMPANY, INC.

P. O. BOX B99 - HICKORY, N. C. 28601

SAVE UP TO 85%

GOV'T SURPLUS and NEW EQUIP'T

Powerful Battery Motor

BUILD MOTORIZED BICYCLE, ELECTRIC CAR, ETC.



F.O.B. Lincoln \$34.95

* (ITEM #1044) - New, Factory Surplus. Motorize bicycles, scooters, children's autos. Drive pumps, tools, compressors. Operate on 24-VDC, 2400-RPM or 36-VDC, 3600-RPM. 1/2-HP. High torque. Shaft diam., 3/4". Flange mtg. 6" diam. Motor 3-1/2" diam. x 9" long incl. shaft. Shpg. 13 lbs. Normal Retail Over \$100.00

SURPLUS CENTER PS-061 Lincoln, Nebraska Zip Code 68501

BIG, Equip't. Catalog

Send 60¢ Coin or Stamps

EQUIPMENT CATALOG

LOWEST PRICES ON

WEED SPRAYING CABLE
GEAR MOTORS WINCHES
SPEED REDUCERS PUMPS
COMPRESSORS TELEPHONES
POWER PLANTS BINOCULARS
HYDRAULICS ELECTRONICS
SURVEYING INST'S HOSE
WELDERS MANY OTHERS

FOR SPEEDIER DELIVERY
PLEASE USE YOUR
ZIP CODE

BUILD YOUR OWN TUCK-A-WAY CHALET!



A DREAM NEST FOR
RECREATION, STARTER
HOME, OR BACKYARD
CABIN FOR THE KIDS!
AMAZINGLY EASY AND
ECONOMICAL TO BUILD.
USE STANDARD TOOLS
AND MATERIALS. NO
BUILDING EXPERIENCE
NECESSARY.

DESIGNED
FOR
MODULAR
HOUSING

FOR INFORMATION PACKET & FLOOR PLANS
RUSH \$3.00 TODAY TO
CHALET • DEPT. 1 • P. O. BOX 1672
BIRMINGHAM, AL 35202

Learn how to MAKE MONEY in DRAFTING

APPROVED FOR VETERANS

CAREERS IN DRAFTING

APTITUDE TEST

FREE! "CAREER KIT"

Train at home in spare time. No previous experience needed. Tools and materials included with course. No special talent required. We show you what to do, how to do it. **LEARN DRAFTING AT HOME!**

NAME _____ AGE _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

Accredited National Home Study Council

NORTH AMERICAN SCHOOL OF DRAFTING,
4500 Campus Dr., Dept. PC051, Newport Beach, CA 92660

CHECK IT OUT!

There are more opportunities,
products and services offered
in the "Classified Opportunity
Mart," immediately following
this section. You may find just
what you've been looking for.

COIN GRAB BAG FREE!



GIANT SURPRISE COIN ASSORTMENTS packed grab bag style from collections* including rare, scarce and valuable coins up to 2000 years old! A real exciting treasure hunt unpicked, unsorted — just as they are received — no 2 assortments exactly alike! Nobody knows what's in them, but each guaranteed to contain our guaranteed \$9.00 catalog value or more for only \$6.98 each plus 75¢ p.p. each. Our Super Size \$18.00 minimum catalog value or more only \$13.49 plus \$1.00 p.p. each. FREE! Order 4 of either size, get 1 same size FREE! Ideal gift for beginner or advanced collector. Hand-some illustrated 32-page Guide, Catalog & Price List included FREE with order, otherwise \$1.00, refunded on first order. VISA or MasterCard accepted. State card number, Interbank No., Expir. date

*Partial List of Coins in Collections:
Half & Large Cents
Flying Eagle Cents
Indian Head Cents
Two Cents
Three Cents
Liberty Nickels
Shield Nickels
Buffalo Nickels
Half Dimes
Seated Liberty 10¢
Barber Dimes
Seated Liberty 25¢
Barber Quarters
Seated Liberty 50¢
Barber Half Dollar
Walking Liberty 50¢
Civil War Tokens
Coins of the World

MATT NUMISS, Dept. PS6 Great Neck, NY 11022

Be an ELECTRICIAN

MAINTENANCE
CONTRACTOR
CONSTRUCTION

Make more money! Check out Electrician's wages against the kind of money you make now!

TRAIN AT HOME IN SPARE TIME

Make extra money in spare time while you train for a full-time job. Do odd jobs for friends and neighbors. Save money doing your own electrical work. Learn everything from repairs and maintenance to complete electrical installations. No previous experience needed. Everything explained in easy-to-understand language with plenty of drawings, diagrams and photos. Tools, materials, test equipment included with course. Approved for Veterans and G.I.'s. Be ready to take almost any electrician licensing examination offered by state, city or county.

No cost, no obligation, no salesman will call!

MAIL COUPON TODAY!

ICS SINCE 1961

Electrician School, Dept. PC051
ICS Center, Scranton, PA 18515

Rush free facts that tell how I can train at home in spare time to be an electrician

NAME _____

ADDRESS _____

CITY/STATE/ZIP _____

BUY A BIKE ENGINE. EVEN IF IT ISN'T ONE OF OURS.

We think we make the best bike engine in the world. Certainly it's the best *selling* bike engine in the world. And now that our 1981 model has a *completely automatic transmission* for only \$189.95, our market share should increase. We would of course appreciate the opportunity to send you our free color catalog, which includes full facts and specs, a Product Report by the Auto Editor of *Popular Mechanics*, and two rather overwhelming testimonials from real people with real addresses.

We may persuade you to buy a BikeBug, or we may not. If not, we urge you to buy any bike engine, gas or electric. In light of the energy crunch, the escalating cost of fuel, and the probability of future shortages generated by greed or political blackmail, any bike engine is part of the solution.

That we think our **BIKEBUG AUTOMATIC** is the best bike engine does not mean that other bike engines are bad. Some are just better than others. Our catalog tells you what's important to look for in a bike engine, and points out problems other bike engines may have. In all honesty, there are reasons why *our* bike engine may not be best for you...and we tell you that too.

You owe it to yourself, not OPEC, to learn and be persuaded about the need for bike engines...ours or theirs.



AQUABUG INTERNATIONAL INC.

Dep't. P886 100 Merrick Rd., Rockville Centre, N.Y. 11570 (516) 536-8217

Please Rush FREE Catalog!

Name _____

Address _____

City _____ State _____ Zip _____

Make \$800 An Hour and MORE
Sparetime or Fulltime

BE YOUR OWN BOSS!
Sharpen Saws
and other tools in Profitable
Business of Your Own

SEND FOR EXCITING FACTS

The Opportunities in a
SHARPENING
Business of Your Own
Fulltime or Part Time
Foley

Free Booklet Tells How

Hundreds of men now using the Foley plan successfully...
... YOU Can Do It Too!

Find out TODAY how the proven Foley plan can quickly put you in a Money-Making business of your own. Work in your spare hours and weekends for extra income, or start a fulltime shop. Set the hours you want to work... keep the profits you earn. Age, education or minor handicaps are no barrier to success. No special skills, experience or huge investment needed — not a franchise. Start in basement or garage. No selling involved, no canvassing — keep 90% profit on every dollar you make. Plenty of business from handymen, carpenters, contractors and industry. **30-Day No-Risk Trial!**

Send for complete facts and details without obligation. Our **FREE Booklet** tells how to start, how to grow, and how Foley will even finance you. **Act NOW!**

Foley

Just fill in coupon below. Mail to:
5129 Foley Building
Minneapolis, Minnesota 55418

Send for FREE Book! CLIP OUT AND MAIL TODAY

FOLEY Manufacturing Co. 5129 Foley Building
Minneapolis, Minnesota 55418

Please send FREE Book about the opportunities in my own sharpening business. I understand there is No Obligation.

NAME _____

ADDRESS _____

CITY/STATE _____ ZIP _____



STAIR-GLIDE® Stairway Lift
America's largest selling stairway lift is the ideal solution for people who can't or shouldn't climb stairs.

- Easily installed
- UL listed
- Will not mar walls or stairs
- Economy and Outdoor models available.

AMERICAN STAIR-GLIDE® CORP.
4001 East 138th, Dept. PS-061
Grandview, Missouri 64030

Telephone Listening Device

Record telephone conversations in your office or home. Connects between any cassette or tape recorder and your telephone or telephone LINE. Starts automatically when phone is answered. Records both sides of phone conversation. Stops recorder when phone is hung up. This device is not an answering service.



Each
\$18.95
Qty. Disc. Avail.

Super Powerful Wireless Mic

10 times more powerful than other mics. Transmits up to 1/2 mile to any FM radio. Easy to assemble kit. 15V battery (not incl.)

Call (305) 725-1000 or send \$18.95 + \$1.00 shipping per item to USI Corp., P.O. Box PS-2052, Melbourne, FL 32901. COD's accept. For catalog of transmitters, voice scramblers and other specialty items, enclose \$2.00 to USI Corp.



SAVE MONEY



Assemble our unique **Magnatrac Tractor Kit**. Buy factory-direct. Catalog of Kit construction and uses -75¢ "Build-it-yourself" Plans — \$7.00 (refunded on any purchase).

STRUCK KIT, Dept. PS61 Cedarburg, WI 53012

Splits
EASIER & FASTER!

THE BOSS LOG SPLITTER!



Only \$49.95 plus \$5 p. & h. for adaptable cone, or \$99.95 plus \$8 ready-to-attach to hub of car or light truck (specify vehicle). Pa. — send 6% sales tax. Free info—send stamped self addressed envelope. **Good Products**, Route 3 Box 88-A PS, Kutztown, Pa. 19530

GREAT OUTDOOR FUN.

SEARCH ELECTRONICALLY FOR... gold, silver, coins and relics with White's Electronics mineral/metal detectors. Pays for itself. U.S. Patented. For your nearest dealer and free catalog



CALL TOLL FREE
1-800-547-6911
White's Electronics, Inc. Dept. PB-1
Sweet Home, OR 97386

**FOR SPEEDIER DELIVERY
PLEASE USE YOUR
ZIP CODE**

STAINED GLASS

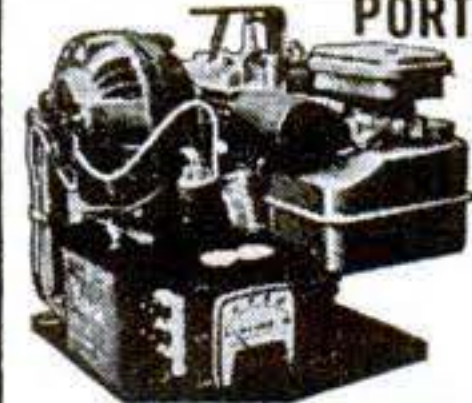


Send 50¢ for fascinating catalog of kits, tools, ideas, books, and supplies.

BIG STARTER KIT
Only \$17.95 ppd.

WHITEMORE, Box 2065DE, HANOVER, MASS. 02339

PORTABLE ELECTRIC POWER



Build your own 110-Volt Electric Plant from used parts. Will operate lights, power tools, heating units, brush-type elect. motors, plus charge batteries and arc weld. Ideal for boats, campers and portable shops. Plans \$9.95 check or M.O. **CHAPALA CO.**
P.O. Box 398, Tustin, CA. 92680

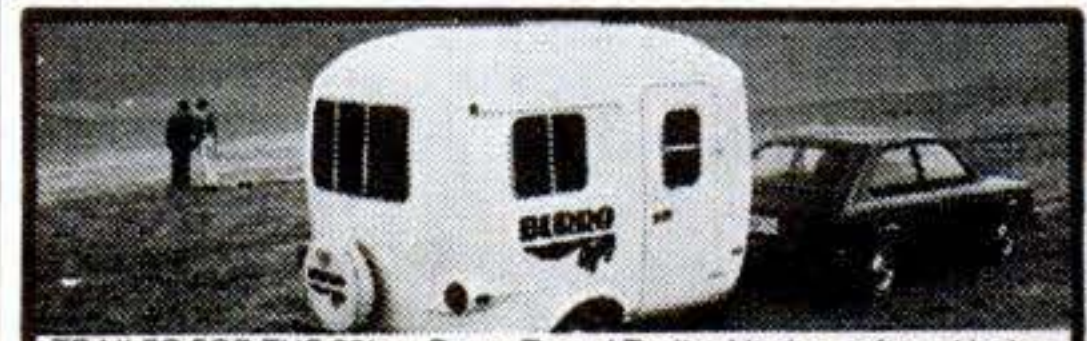
SAVE YOUR GAS... let YOUR mail do the shopping



A BUSINESS OF YOUR OWN REPAIR HYDRAULIC JACKS



Earn while you learn at home. Millions of jacks in gas stations, trucking firms, etc. need servicing. We show you HOW. Start spare time in your basement or garage. Big opportunity for mechanics. Write for folder No. PS6, and free bonus offer. **HYDRAULIC JACK REPAIR MANUAL CO., INC.**
G.P.O. BOX 3 • STATEN ISLAND, N.Y. 10314



TRAILER FOR THE 80's—Burro Travel Trailer kit sleeps four. Under 1,000 lbs. Fiberglass. Ready to tow. Finish interior only. Write Burro PS-6, 14143-21st Avenue North, Plymouth, MN 55441. For full color catalog send \$2.00 to cover postage and handling. **Dealers Wanted.**



GAS TO ELECTRIC CONVERSION KIT

2 bulb fixture duplicates the *charm* and increases the light output of any existing double mantle gas lamp. Kit includes on-at-dusk, off-at-dawn photo control, fixture, bulbs, detailed instructions. As low as 40¢ per month to operate compared to \$6.00 with gas. The 'RELITE' kit is available in both 115 volts and 12 volts (with plug in transformer). Ask for the 'RELITE' kit at your local hardware store or write for more information. **Dealers and Installers inquiries also invited.**

YARDLIGHTING SYSTEMS INC.

1039 CHARLES AVE., DEPT 10 • ST. PAUL, MN 55104

EASILY REPAIR OR MAKE CLOCKS

For Fun & Extra Income With A Super Accurate Quartz Battery Operated Clock Movement. Many To Choose From! Also Dials Hands and Numerals At Very **LOW** Prices! Free Catalog - **SEND TODAY!**

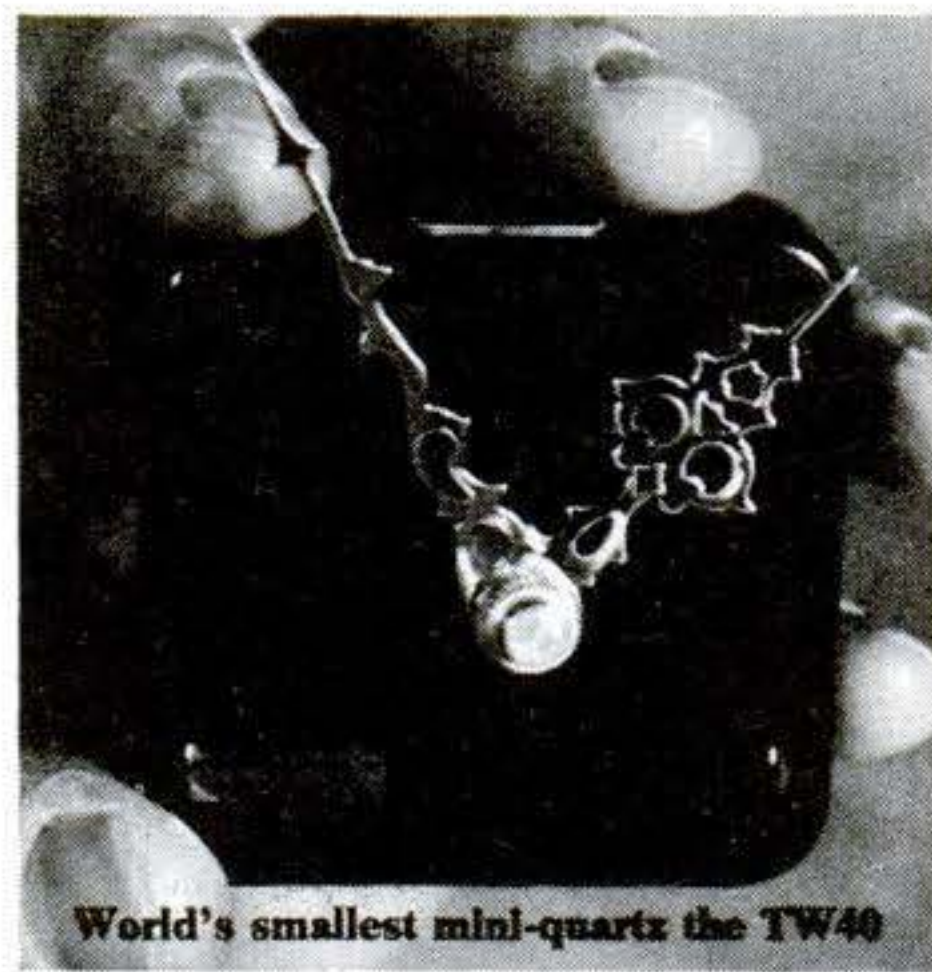
WRITE:



KLOCKIT

DEPT. PS-6, P.O. BOX 629
LAKE GENEVA, WISCONSIN 53147

For 1st Class Catalog Delivery - Send 50¢



World's smallest mini-quartz the TW40

ONE FOR ONLY \$7.25, 3 FOR ONLY \$6.80 ea.
S-300 SWEEP: ONE FOR \$.25, 3 FOR ONLY \$.20 ea.
Add \$2.00 for Shipping & Handling in U.S.A.

**FREE HANDS WITH EACH
MOVEMENT PURCHASED**

MUSCLES

HOW TO BUILD A MORE POWERFUL BODY!!

- Wider Shoulders • Bigger Arms • Powerful Chest
- Trimmer Waist • Lose Fat • Gain Weight • And get a V-SHAPED BODY!!

FREE BOOKLET!

Universal, Dept. B
Box 6694
Detroit, MI 48240

**FOR SPEEDIER DELIVERY
PLEASE USE YOUR ZIP CODE**

RICKA DUO-WHEEL CONVERSION KIT AND FIBERGLASS FENDERS



New wide tire adapters & fenders to fit most mini - 1/2, 3/4 & 1 ton trucks. Simple bolt on installation. Increases traction, tire capacity & life.

The ultimate in safety protection for your family.

**RICKA MFG.
DEPT. RPS-6**

Pequot Lakes, MN 56472

THE TOOL WAREHOUSE

Name Brand Tools at 10% to 50% Off

S-K TOOLS
Rockwell

MILWAUKEE

SKIL

STANLEY

EDISON® 10" BAND SAW



• 10" Throat
• 4" Depth
• 1/2 HP Motor
• 0-45 Table

\$139.95
Retail \$174.95

Extra Blades \$6.00 ea. 1/4 or 3/8 add \$8.00 for shipping and handling

ORDER BY PHONE WITH MC OR VISA

800-645-9166

516-420-1420

SEND \$1.00 FOR CATALOG
CALL OR WRITE FOR OUR PRICE
ON ANY NAME BRAND TOOL!
SORRY NO C.O.D.'s
PRICES FOR CONTINENTAL USA ONLY

1/2 H.P. BENCH GRINDER



HEAVY DUTY INDUSTRIAL QUALITY
• 6" Wheels • 3400 RPM • 110/220V
• 8" Wire Wheels add \$5.00 ea.

add \$8.00 for shipping and handling

THE TOOL WAREHOUSE
WILLOW PARK CENTER
FARMINGDALE, N.Y. 11735
Att. Dept. PS-681

Eyeglasses. Save up to 50%.

Send for free catalog - all lenses - all styles. As low as \$14.95 complete. Your prescription, or your present lenses duplicated. Money back guarantee. Now you can afford extra pairs.



Est. 1959

Prism Optical, Inc., Dept. PS-61
10992 N.W. 7th Ave., N. Miami, FL 33168

Clock Components



Clock Movements: Battery, Quartz, Electric, Urgos Grandmother, Grandfather, Westminster & Triple Chime, 8 Day Key Winds & Westminster, Bim Bams, Barometers, Metal, Bezel, Paper dials, Hands, Brass & Plastic Numbers & Markers. Hundreds of Items. Quantity Prices. Send \$1.00 for 60 Page Catalog. Refunded on \$10.00 Order.

NEWPORT ENTERPRISES, INC. DEPT C
2313 W. Burbank Blvd., Burbank, Calif. 91506

CLASSIFIED OPPORTUNITY MART

AUTOMOBILES

MILEAGE INCREASES TO 50%! Forget gimmicks - in two hours convert V-8's to V-6's or V-4's. Details \$2.00. Mason Industries, 6417 Carrollton, Indianapolis, IN 46220.

INSTALL DIESEL GET 30 MPG. Car, pickup or RV. Overlooked source available. American diesels, 6 cylinder 550 lbs. reasonable. Details \$14.95. Leibert's, Rt. 4, Box 70, Walla Walla, WA 99362.

ULTIMATE MPG FUEL SYSTEM Atomize and Vaporizes gasoline 1000% + MPG increase possible. Details, Drawings \$10.00. NSM, P.O. Box 319, Hornbrook, CA 96044.

FOUND: The legendary "200 MPG Carburetor." Mileage documented. We have complete plans, how-to secrets. Build your own, or modify present carb. Revealing "How-To" Report \$1.00. H. & A., PS6, P.O. Box 438, Bowling Green, MO 63334.

ELECTRIC CARS - Current Listing Of American Manufacturers And Study Groups, \$1.00. Page, Box 70046E, Eugene, OR 97401.

AUTOMOBILE RE-TUNING FOR MAXIMIZED ECONOMY. Simplified techniques increase MPG 50+ %! **DETAILS FREE!!** Technear, Box 12191CC, Norfolk, VA 23502, Telephone (804) 495-2033 (recording).

INVENTION: 100 MPG Conversion, \$5.00. Homecraft, 2350 W47A, Denver, CO 80211.

SECRETS OF FANTASTIC ECONOMY!! Details **FREE** - Avtek, Box 5202-L6, Rockford, IL 61125.

PROPANE/GASOLINE Dual-Fuel Conversion Manual \$5. Manufacturer-Direct. Kit \$295. Check/Visa/Mastercard. Pro-Power, 1901 Morena, San Diego, CA 92110.

ELECTRIC CAR PARTS. Catalog contains parts, plans, instructions. Send \$3.00 to Electric Vehicle Components Catalog. Flight Systems, Dept. EV8, P.O. Box 25, Mechanicsburg, PA 17055.

SOUND ADVICE FOR USED CAR BUYERS. Inside Information that will save big money. Realistic approach. Details \$4.00. N.S. Auto, Rd. 2, Beaver Falls, PA 15010.

SECRET 200 MPG Carburetor Revealed! MPG-PS681, Box 2133, Sanlusk, OH 44870.

1A ELECTRIC VEHICLES

NATURAL GAS charged tank, not electric charged battery! Same principle, different utility, much cheaper! Send \$20.00 for tested plans; Step by step photos; parts list. New low pressure system converts your present vehicle to methane fuel. Satisfaction or money refunded. Natural Fuel Inc., Rt. 3, Box 1750S1, Pearland, TX 77581.

FULLY-ENGINEERED ELECTRIC CAR CONVERSIONS the 80's TOP-PERFORMANCE EVs from cars of the 60's and 70's

Our EV CONVERSION GUIDEBOOK shows how your electric vehicle can outperform DoE's best demos at a fraction of their cost.

NASA-sponsored tests prove our control system gives 4 to 21% more performance than chopper-controlled EVs. Efficiency & simplicity excel! GUIDEBOOK provides full data & plans (for any car). With step-by-step worksheets to maximize your choice of speed, range or mi/kwh.

Detailed SUPPLEMENTS also for: Beetle, Chevette, Civic, Datsun 210, Fiat 128, Pinto, Fiesta, Rabbit & R5/LeCar. 14-day exam, money-back guarantee. Order yours at no risk, today. GUIDEBOOK \$14.50 BOOK & 1 SUP. \$18 BOOK & 3 SUP. \$24. 3E Vehicles, Box 19409-AD San Diego, CA 92119 (Or phone (714) 448-3725, VISA or MC, for Next Mail Return)

2 AUTO SUPPLIES & EQUIPMENT

FUEL LINE MAGNETS As seen on T.V. Complete kit \$12.95 Full instructions, P.O. Box 205, Joppatowne, MD 21085.

CHEVY VEGA OWNERS! "QUENCH" Head gives super gas mileage! Bolt on! Guaranteed! Write for free catalog of Vega performance improving products! **ECON-O-MOD**, 3205B Production, Oceanside, CA 92054, (714) 433-1532.

ALTERNATOR Generator Rebuilding Book, Details: Hedelund Engineering, 7505 Barkentine, Las Vegas, NV 89128.

MILEAGE INCREASED 10 TO 50%. Copyrighted Publication \$3.95. **BETTER MILEAGE**, Box 1006, Mena, AR 71953.

ANTIQUE Ford Parts, Restoration Supplies, Catalog \$2.00. Mark, Layton, NJ 07851.

BESTOS Gasoline Supply for Car, Boat, Mower. Easy Installation. Details \$1.00. Bestos, Box 612, Oconomowoc, WI 53066.

PROPANE Carburetor Dual Fuel Conversion \$39.95. NuPropane, Box 1210, Glendale, AZ 85304.

STOP AUTO THEFT, new electronic auto immobilizers stops theft in seconds. Details \$1.00, refundable. Tsang, P.O. Box 9193-AA, Newark, DE 19711.

VOLKSWAGEN - AUDI - PORSCHE, Parts. Top Quality, Extensive coverage. Wholesale catalog \$2.00. Mike Distributing, Box 729S, Bloomington, IL 61701.

HONDA 4-DR ACCORD Owners - Install a front seat arm rest. Attractive. Improves driving comfort 100%. Details: Husco, 17 Calvin Rd., Wilton, CT 06897.

100 MPG? Carburetors that can. Plans \$9.95. Carbs, P.O. Box 452, Bellingham, WA 98225.

ALTERNATOR Generator Rebuilding Book, Details: Hedelund Engineering, 7505 Barkentine, Las Vegas, NV 89128.

ALL purpose fire extinguisher 2 3/4 lb. U.L. rated A.B.C. Dept. of Transportation approved. Every auto should have one. \$29.50 each. S & T Industries, Inc., 2306 NE Glisan, Portland, Oregon 97232.

3 AUTO TRAILERS & CAMPERS

CAMPER/TRAILER KITS - PLANS - Fifth Wheels - Vans - Covers - Motorhomes - Simple construction - Save! Catalog \$1.00. **GLEN-L R-V'S**, 9152 PS Rosecrans, Bellflower, CA 90706.

BUILD your own Trailer easily. Boat, Utility, Horse etc. Using Flex-a-Ride suspension units. For more information send \$1.00 for brochure to: Dept. D, P.O. Box 25, Everett, Ontario, L0M 1J0 Canada.

PORTABLE smoke and fire alarm for use in travel trailers, motor homes, hotels, motels, cabins, recommended for travelers safety \$29.95 each. S & T Industries, Inc., 2306 NE Glisan, Portland, Oregon 97232.

4 MOTORCYCLES, BICYCLES & SUPPLIES

BUILD AN ELECTRIC REAR DRIVE SYSTEM FOR YOUR BIKE. Send stamped self addressed envelope for details. MER, P.O. Box 5113, Eugene, OR 97405.

ELECTRIC BIKE, BUILD YOUR OWN. Complete illustrated instructions on converting your bike. \$15.00. Future Creations, P.O. Box 05283-PS Detroit, MI 48205.

BICYCLE TRAILER. Convert Your Bike to Efficient Load Carrier, Groceries, Children, Touring Gear. Details: Equinox Industries, 1142A Chestnut Street, Cottage Grove, OR 97424.

FACTORY DIRECT! go cart

New plans reveal step by step details on how to build your own Go Cart! NEW welded Go Cart frame kits! **FREE** coupons! **RUSH \$3 for plans & Giant Catalogue to:**
Box 34304, Dept. PS6, Omaha, Nebr. 681340010

5 AVIATION

SPACE SHUTTLE POSTER, 30 x 42, Color, \$5.00. Sunshine Company, P.O. Box 1055, Palm Bay, Florida 32905.

BOOMERANGS - INCREDIBLE RETURN! You can do it. Exciting! Order your **FREE** catalog today. Boomerang-Man, 312 Park, Monroe, LA 71201.

BI-PLANE HANGGLIDER. Build for under \$150. **PLANS** \$8.00. David Barbour, 38 South Bridge Street, Poughkeepsie, NY 12601.

ULTRALIGHT FLYER - monthly newspaper, \$6 annually. Ultralight Flyer, POB 98786, Tacoma, Wash. 98499. Use Visa, Mastercharge, phone (800) 426-8538.

FANTASTIC TOY Cardboard PLANE - Flies 100 Feet. Airborne By Elastic. \$5.00. Univerce Transit, 576 Varsity Road, S. Orange, NJ 07079.

ROCKET PROPULSION SYSTEM

Build your own hot gas generator that propels you approximately 85 feet high at 60 MPH! Send \$10.98 for info-pack to:

PROPULSION
P.O. Box 2624
Arlington, Va. 22202

AIRCRAFT KITS Complete Detailed Plans

Fuel-efficient & High-performance Aerobatic & Cross-country
1, 2 & 4 Seat
MANY TYPES
SEND TO: **LIGHT FLIGHT PRO.**
Dept. C ★ P.O. Box 19828 ★ Houston, Texas 77024

BUILD A JET HELICOPTER EASY TO FLY—INEXPENSIVE TO BUILD!

• Carries one person-plus
• Uses low-cost fuel
Plans—completely illustrated: \$8.00
HELICOPTER EXPERIMENTER'S HANDBOOK (many illustrations): \$5.00
PLANS AND HANDBOOK: only \$11.00
HELICRAFT

P.O. Box 16488-A Baltimore, MD 21217

5A HOVERCRAFT

HOVERCRAFT Plans. Catalog \$1.00 Universal Hovercraft, Box 281, Cordova, IL 61242.

AERO-CAR Amazing Hovercraft built easily with ordinary tools. Lawnmower engine powered. Carries one man plus. Flies over land/snow/water. Complete plans and booklet. \$9.95. Aero-Projects, Box 5118PS, Clinton, NJ 08809.

BARTLETT Flying Saucer, Complete Plans/Supply Sources: \$3.00. Write: Herb Bartlett, P.O. Box 156-S, Silverdale, WA 98383.

6 ASTRONAUTICS

ANTIGRAVITY Propulsion Device Free Brochure, RDA, Box 873-N, Concord, NC 28025.

SUPPRESSED DISCOVERIES. Gravity Control. Proven new energy systems. Free information. Enclose addressed stamped envelope. Spacecraft Research Foundation, 1858 Carlotta Drive, Concord, CA 94519.

ANTI GRAVITY

ELECTRONIC LEVITATION No moving parts, magnets, gases or exotic fuels. **BUILD FLYING MODELS.** Plans, schematics, diagrams, performance charts & more in **PRIMER VOL.** 105 pgs 8x10 mimeo \$20 pgs. **GUARANTEED!** VISA/MC add \$5. **FORIEGN** ADD \$10. **SAUCER TECHNOLOGY**, Box 132-A, Eureka Springs, Ark. 72632

Continued on page 138

JUNE 1981 | 137

Copyrighted material

CLASSIFIED OPPORTUNITY MART

Continued from page 137

7 BOATS, INBOARD & OUTBOARD MOTORS

EVINRUDE 1980 Bargains... all sizes... \$1.00 handling... Scott-McCulloch parts... Electra Marine, 610 Merrick Road, Lynbrook, NY 11563.

BOAT KITS—27 Trailerable models —**POWER and SAIL**—11' - 30', Molded fiberglass hulls and decks come factory assembled - you install factory supplied interior. Save half factory-built cost. No experience required. **FREE** 48 page Catalog. Luger, Dept. AC-81, 3800 West Highway 13, Burnsville, MN 55337. (612) 890-3000.

GOVERNMENT Surplus Boats, Information, Sample catalogue, \$3.00. Surplus, Box 66, Jonesport, Maine 04649.

WHOLESALE-Boats, Motors, Marine Supplies Compare our prices and save on Evinrude, OMC, & Crusader Engines, Electronics, Paints, Fiberglass, Fasteners, Propellers, Controls & Steering Systems, Safety Gear & Appliances are only a few of over 300 Marine Manufacturers that we represent. We also have a 400 page catalog available for only \$10.00 or you may request our monthly mailing list of specials free of charge consisting of items at or below dealer cost.

WAGNER WHOLESALE MARINE
3700 Lapalco Blvd., Harvey, La. 70058
or phone 504/340-9221 Ask for Warren
Serving The Marine Industry For Over 40 Years

BOAT PLANS - FRAME KITS - PATTERNS - Powerboats - Sailboats - Outboards - Canoes - Kayaks - Rowboats - Duckboats - Houseboats - Runabouts - Dorries - Workboats - Fishing Boats - 8' to 49' - Construct In - Plywood - Cold Molded - Wood/Epoxy - Fiberglass - Steel. Lowest cost, highest quality! Easy, proven methods include instructions especially for amateurs. No lofting! **SUPPLIES** - Fastenings - Fiberglass - Resins - Glues - Spars - Books - Trailer Plans. **HUGE 144-page catalog** - \$2.00 - Includes **FREE "BOATBUILDING SUPPLIES"** brochure. **GLEN-L Marine**, 9152 Rosecrans, Dept. SP, Bellflower, CA 90706.

BOATKITS - PLANS - PATTERNS - FRAME-PACS - FIBERGLASS - MATERIALS - World's largest catalog - 300 Designs - 8'/80' - Plywood - Fiberglass - Steel - **POWERBOATS** - Inboards - Outboards - Cruisers - Sportfishers - Hydroplanes - Runabouts - (**KAYAKS CANOES** - Large Selection) - **SAILBOATS** - Daysailers - Trailersailers - Multihulls - Motor Sailers - **FIBERGLASS** - Cloth - Resins - Foam - C-Flex - **CATALOG \$2.00** - "Includes **FREE** Materials Brochure - Hardware - Fastenings - Equipment - Riggingsails - Glue - Etc." - (Book **"AMATEUR BOATBUILDING"** - In - Fiberglass - Plywood - Epoxy/Wood Saturation Technique - \$6.00).

CLARKCRAFT

16-S Aqua Lane, Tonawanda, NY 14150

11 DO-IT-YOURSELF

HEAT EXCHANGER easily made from readily available material. Instructions \$5.00. Pleiade Research, P.O. Box 90, Hillsdale, MI 49242.

SCRAMBLED TELEVISION SECRETS! Manual includes theory, circuits, decoder dealers: \$14.95. Kits available. Information package: \$2.00. ABEX, P.O. Box 26601-PS, San Francisco, CA 94126.

POOL CHEMICALS — No Nonsense Purchase and Application Guide \$3.00. Aquatech, Box 187, Midland, MI 48640.

ELECTROPLATING, Complete Textbook. All Metals. Electroplate Metallic/Nonmetallic Items, \$9.95. Details Free. Tropic, Box 95P, Palm Bay, FL 32905.

MAILBOX PLANS — Attractive Birdhouse Design. \$3.00 to: R. Howard, 6112 Pembridge, Toledo, OH 43615.

LASER HANDBOOK with burning, cutting, Ruby Reds, Co's complete plans, books, and parts. Send \$4.00 to: Famco, Dept. PS, Box 1902, Rochester NH 03867.

FREE CATALOG of Formulas, tips, remedies, plans, Methods and Instructions. Send to: Nile, Box 3520, Nashua, NH 03061.

EASY to make charcoal starter. Keep hands clean. Start briquets rapidly without fluid or electric starter. Instructions \$2.00. **ECRAFTAC**, P.O. Box 513, Austin, TX 78767.

CLASSIFIED ADS \$6.00 per word, per insertion. Minimum 10 words. Payment with order, or charge to your Visa or Master Charge (give number & expiration date). First word in bold capital letters, rest of ad upper & lower case. Other bold cap words, \$1 per word extra. Bold headline or white space, \$24 per line. **DISPLAY-CLASSIFIED \$330** per inch, per month. Advertisers using a P.O. Box number must furnish complete name and street address for our records.

CLOSING DATE for August issue (on Sale July 15) is May 28. Send orders to Mary C. Ansbro, Classified Adv. Director, Popular Science, 380 Madison Ave., New York, NY 10017.

SOLAR WATER HEATING. Inexpensive system. Build for under \$500.00. Plans, instructions, Material list \$14.95. Stan Allen, 1089 N. Cobb, Porterville, CA 93257.

DON'T PAY YOUR PHONE COMPANY! Save money. Install your own telephones. Booklet \$5.95. J.J. Associates, 502 Main, Peck, ID 83545.

FIRESAFE HOMES DIVISION OF NATIONAL AUTOMATIC SPRINKLER SYSTEMS INC. OFFERING ARCHITECTS, ENGINEERS, BUILDERS, HOMEOWNERS OUR INSURANCE UNDERWRITERS APPROVED DESIGN SERVICE. **DESIGN KIT AND PRICES \$2.00**. 114 N. COLLINS, PS, TULLAHOMA, TN 37388.

ELECTRICITY BY CONSUMING 6 PEPSI CANS. Powers, Lamp, Small Motor or MiniTV. Make simple reusable electrodes. Patent pending Instructions and drawings \$5.95. **SALU/CELL**, Box 275, Penn Valley, CA 95946.

MATH BY MAIL. Free course. To receive 1st lesson, write to: Mike Jones, 3712-A Tulsa Way, Fort Worth, TX 76107.

12VDC TO 120VDC (HOUSE POWER) CONVERTERS from junk TV transformers. \$10.00 parts cost. Instructions, schematics, parts list, \$5.50. Royway, P.O. Box 1634, Little Rock, AR 72203.

SUBSCRIPTION TV DECODER kit \$39.00. Includes parts, manual and etched board. Manual only \$4.60. Catalog \$2.00. Joe, P.O. Box 61, Cumberland, RI 02864.

ELECTRIC WELDER from small air-cooled engine. Complete plans \$5.00, information \$1.00. E.J. Mazurek, 34 Trinity Circle, Dollard, Quebec, H9A 1N1.

SATELLITE Television Information - Build or Buy Your Own Earth Station, U.S. \$4.00 - Satellite Television, RD3, Oxford, NY 13830.

SOUTH-FACING WALL should help heat your house 30-50% next winter and forever. Local materials \$100-\$500. Simple plans, only \$14.00. Can-Am Tech., 390 Reeceville Rd., Coatesville, PA 19320.

POOL TABLE — Plans \$5.00, kits available. Free details. Quest, Box 13077, Edwardsville, KS 66113.

ROBOT DESIGN BREAKTHROUGH. Easily Built, Untrappable, Controlled with 4 Bit Input, Microprocessor Adaptable. Complete Plans with 24x36 Blueprint \$6.95. Free details. Zamis Engineering, 251 First Street PS, Perrysburg, Ohio 43551.

RECEIVE 80 television channels by satellite! Secrets revealed. \$1.00. Meier, Maple St.-S. Charlevoix, Michigan 49720.

ION GENERATORS, Outperform \$200 Models. Kit \$64.50, Complete \$79.50. Professional Ionizers, 2146 Wellington, Wichita, KS 67203.

HOW TO MAKE ONE-WAY MIRRORS. Materials and method. No special tools required. Send \$3.00 to: McCullagh Manufacturing, R.R. 1, Charlton, Ontario, P0J 1B0.

FOOD DEHYDRATOR plans, \$5.95. A&J Enterprises, Box 1803-PS, Provo, UT 84601.

GASOHOL. Make your own from legal still! Send \$1.00 for Double Refundable Offer! Researches, Drawer AF, University, AL 35486.

CONVERT TABLE -- Coffee, End, Card Table. Storage Chest, Magazine Rack. All in one. Send \$3.00 for plans. Box 234, Springfield, OR 97477

LASER

LASER OR MASER PISTOL — COMPLETE

Plans for Building—\$3.00 each
T-Rod—\$16.00
INVISIBLE FORCE
FIELD—\$2.00. **MOON**
MAN ROBOT—\$2.00

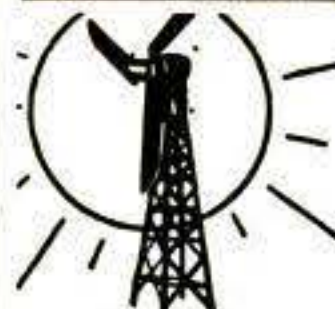
SOUND LASER
Ion Aeronautical Lift System \$5.75

Real Ruby Crystal 1/4"x2" for educational use \$225.00

High Power CO₂ Laser \$5.75

Catalog of super Science Projects—\$1.00.

JACK FORD SCIENCE PROJECTS
PO Box 948A, Duluth, GA 30136



Wind/Methane
Solar/Fuel Cells

Enjoy free heat & power. Send for energy Encyclopedia. Complete list of Mfg., cost, specifications, on most alternate sources of energy - Plus Catalog of Plans available for do-it-yourselfers. —\$4.00

Energy Service
14A Hughey St., Nashua, NH 03060

Satellite TV

Sick of Network TV? **FOR THE HOME**

Our receiver lets you get over 75 channels of television directly from earth-orbiting cable TV satellites! HBO, Showtime, super stations, sports and movies.



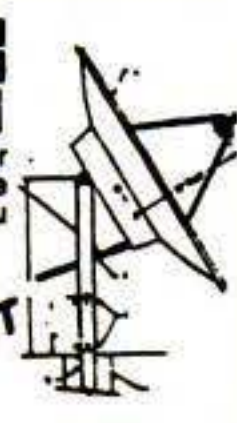
We don't just sell information! We Manufacture Hardware!

Constantly updated, our **94 Page** technical information book and catalog gives you all the facts. Inexpensive dishes, feeds, telemetry software, kits and more. Recommended reading by NASA, The Office of Consumer Affairs and quality companies like Rockwell/Collins. Send \$7.95 today!

CALL
24-hrs. C.O.D. Hotline
(305) 339-7600
SPACECOAST™
RESEARCH CORPORATION
P.O. Box 442-B, Altamonte Spgs, FL 32701

SATELLITE VISION

We manufacture the highest spec 3-meter data & video dish in the world 41db gain! We also sell direct. Immediate delivery or you pick up. Complete details including satellite TV information, aiming service and discount schedule. Send \$1.25 for postage & handling to:
TIGER TENNAS
P.O. Box 561
Casselberry, Florida 32707



SCIENTIFIC SYSTEMS INC.
Now at last offers in kit or completed such unique products as: Nighttime vision vices, super sensitive directional mikes, and high powered lasers, micro-mini-v transmitters, ultra sonic devices, super voltage generators, intrusion and sensing vices, scientific personal protection ite and many other hard to find products. \$1.00 for catalog: **SCIENTIFIC SYSTEMS** Dept. S1, Box 716 Amherst, NH 03

FANTASTIC SCIENCE PLANS

Stero-Controlled Laser Show \$ 8.00
Methane Fuel (400 pages) 15.00
Hydrogen Generator/Hydrogen Car 10.00
Propane/Gasoline Auto Conversion 10.00
MHD Electrical Generator 10.00
Low-Cost/One-Man Hovercraft 7.00
Easy-to-Build X-Ray Machine 10.00
Solid State Laser 6.00
Visible-Red He-Ne Laser 6.00
25 KV Tesla Coil 5.00
Computerized Electronic Robot 10.00

MONEY-BACK GUARANTEE

— CATALOG \$1.00 —
RESEARCH & DEVELOPMENT

Post Office Box 873
Concord, North Carolina 28025

HYDROGEN FUEL

Now, you can generate your own hydrogen and convert your automobile to operate on hydrogen fuel. You get electrolyzer and auto conversion plans and instructions, plus details on safe hydrogen storage and generating hydrogen **FREE!** Complete package: only \$10.00

RESEARCH & DEVELOPMENT

Post Office Box 873
Concord, North Carolina 28025

LASERS UNLIMITED

Complete plans and parts sources
• RUBY LASER RAY GUN \$15.00
• CO₂ LASER FOR BURNING/CUTTING \$15.00
• BEGINNERS LASER VISIBLE RED and IR .. \$10.00
• LASER PISTOL and RIFLE \$10.00
• VISIBLE RED LASER LIGHTGUN \$10.00
• MULTI COLOR LASERS \$10.00
• LASER LIGHT SHOWS \$12.00
• LISTING OF LASER BOOKS & COMPANIES \$ 7.00

LASERS UNLIMITED

Dept. L1, Box 716, Amherst, N. H. 03031

Takes the guesswork out of laying concrete blocks. Clip-on Spacers let you space blocks evenly in every direction without using a level. A set of 12 spacers costs \$19.95 and is enough to lay 11 blocks before they are snapped off for re-use. For brochure write:

DENCO INC.
Box 175
Onalaska, WI 54650

FALLOUT SHELTER

Are you prepared? Protect you and your family from deadly radiation. Easy and inexpensive to build shelters. Plans with survival instructions, \$19.95 + \$1.25 pst & hnd.

JRB MARKETING

P.O. Box 22000 - 391
Tempe, AZ 85281



BIG SCREEN TV \$499!

Brilliant 4-foot picture from your own TV. Guaranteed! 60-day free trial. Free 10-page brochure from

VSR, 433 Airport Blvd
Suite 419PS,
Burlingame CA 94010

UMP
RAIN • IRRIGATE
CIRCULATE • SPRAY



Heavy-duty rustproof ball-bearing pump. Stainless steel. 1 HP 1200 GPH 60' high. 1000 GPH 25' well. 5200 GPH max. 1 1/4" in. out. Belt or direct drive. Use 1/4 HP or larger. Money back guarantee. Add \$2 postage & handling. \$21.95
BAWCO Box 35, Belle Mead, N.J. 08502

HOT TUB CATALOG

"They swear we don't exist"
Whole Hot Tub Catalog & Directory. Wholesale Bible! Hundreds of listings save you hundreds of \$\$'s on energy efficient systems, including Solar. \$2.95
Build your own — Plans for "THE CUBE" includes tile spa adapt. & super efficient PERMA-AT SYSTEM stays hot yr-round \$6.95
MARRIS IND. • Box 483 • Sausalito, CA 94966

JEWELRY APPRAISAL
EASY WITH GRAM SCALE
SHOWN, KARAT TABLE,
CLEAR INSTRUCTIONS,
MAGNIFIER, ONLY \$8.50
VALUE GUIDE
P.O. BOX 2505
ORMOND BCH., FLA. 32074

AMAZING SCIENTIFIC and ELECTRONIC DEVICES

PHASER shockwave and invisible FORCE FIELD generators. LASERS for weapons, cutting, burning, cloud writing, holography and special effects. NUCLEAR particle accelerators and detectors. PLASMA, ION, HIGH VOLTAGE, HIGH FREQUENCY TESLA COILS and LIGHTNING generators. TRANSMITTERS and CONTROL devices for security, telephones, intrusion detection, nature listening, PLUS PLUS INFRA-SONICS, ULTRASONICS, ENERGY, CHEMICAL and PERSONAL PROTECTION and SAFETY DEVICES. SEND \$1 for catalog of plans, kits and completed items to:

INFORMATION UNLIMITED, INC.
P. O. BOX 716, Dept. P8
Amherst, N. H. 03031

12 HOME CRAFTSMAN

PROFITABLE SECOND INCOME. Make beautiful, small, utility bandsaw boxes from common lumber. High demand in gift and stationery stores, craft fairs. Illustrated instruction booklet for 10 proven original designs, \$6.00. Box-art, Dept. C, Box 20, Clarendon Hills, IL 60514.

1400 CATALOGS listed and described. Sources for everything imaginable. \$4.00. Masterlog, Box 879-A, Fairfax, CA 94930.

\$35.00 WORKBENCH! Craftsmans' quality! Outstanding rigidity/strength! Easy build plans \$5.00. Can-Am Designs, Box 313, Ajax, Ontario, Canada. LIS 3C5.

Adjustable & Tilttable FOLD & STOW IN 6" SPACE



"Adjus-Tilt" Omega Frame"
STURDY STEEL TUBES AND "SPECIAL ALUM CASTINGS". KEEP UNIT SQUARE, EASY TO FOLD, PLUS QUICK MOUNT FOR WORK-SURFACES. VERSATILE IN ALL HOME AND SHOP PROJECTS. IDEAL FOR DRAFTING BOARDS. ADJUSTS 28"-44" HIGH, 33" W 44" L. SHIPPING Wt. 40 LBS. CASTER SET, SHIPPING Wt. 7 LBS
\$98.89 Includes S&H in USA
CASTER SET EXTRA \$30.50
TAX 6% CALIF. NO C.O.D.S SEND \$1.00 FOR BROCHURE REFUNDABLE ON PURCH. CHECK OR MONEY ORDER. MASTER & VISA. EXP. DATE, ALL NUMBERS & SIGNATURE.
Alpha & Omega Company
DRAWER 305 • CERRITOS, CALIF. 90701

"GETTING Started in Stained Glass"
50c. Whittemore, Box 2065X, Hanover, MA 02339.

HOT TUB PLANS; 17x22 sheets, photos \$15.00. Box 1420, Sequim, WA 98382.

CLOCK MOVEMENTS and accessories. Catalog \$1 (refundable) Elcraft, POB 1521-DV, Huntington Beach, CA 92647.

12A FOR THE HOME

RECLINABLE - Relax while watching TV or reading in bed. Build one. Free information. Novelty House, 1242 S. Belvoir, Cleveland, Ohio 44121.

13 TOOLS & MACHINERY

WOODWORKERS — SUPPORTABLE offers increased safety, accuracy, convenience, when sliding large materials off shop tools onto **SUPPORTABLE'S** ten wide rollers. Info. \$1.00. Turning-point Mfg., Dept. C1, Davenport, ND 58021.

4" METAL Cutting Lathe \$76.25. Taig, 15048 Proctor, Industry, CA 91746.

SMALL FOUNDRY Furnace, Supplies. Free Literature. Pyramid Products, Dept. M, 3736 South 7th Avenue, Phoenix, AZ 85041.

MACHINERY - POWER TOOL CATALOG 25c WILKE MACHINERY, 1519 Mt. Rose, York, PA 17403.

LATHES — Unimat — Maximat — Sherline — Machineex. Catalog \$1.00. Shop Supplies \$1.00. Campbell, 2100P Selma Road, Springfield, OH 45505.

MACHINIST'S WALL CHART. Just introduced. Makes all other reference charts obsolete. Combines U.S. threads with tapping and clearance drills, English threads, inch decimal equivalents and drill sizes, U.S. pipe threads, other useful data on 24x37 oil-resistant chart. Write for information. Chester River Machine Tool Company, Drawer 119B2 Chestertown, Maryland 21620.

14 ENGINES & MOTORS

KOHLER — Sachs, CCW, Bosch, Skiroule parts distributor. Many surplus parts. Growth Products, Inc., 124 Lake St., Crystal, MI 48818. 517-235-4294.

CONVERT Gasoline Engines To Steam. Information \$5.00. P.O. Box 185, Farm-land, IN 47340.

STIRLING ENGINES ARE COMING! **LEARN** about a silent but efficient engine that uses any source of heat and is safe. A newsletter, books, films, engines, computer programs, and consulting services are offered by MARTINI ENGINEERING, 2303 Harris, Richland, WA 99352. Send \$2 for introductory booklet and catalog to Dept. PS 061.

ENGINES to 19 H.P. for Mowers, Tillers, Hobby. Repair manuals parts. Tremendous savings. Fast, dependable. Illustrated price catalog \$1.00. Ashland Small Engines, Ashland, MO 65010.

15A ENERGY SAVING

ENERGY saving fans. Residential and commercial. P.O. Box 06766, Ft. Myers, FL 33906.

GENERATE ELECTRICITY with unmodified induction (washer type) motor. Reverse electric meter. Simple! Legal! Instructions \$3.95. E.P.S. Box 3572, Shawnee Mission, KS 66203.

NEW — Ground Coil — Proven cheapest whole house heating and cooling. Any climate. Plans \$10.00. R. Petry, Box 285C, Stanchfield, MN 55080.

SLOW DOWN YOUR ELECTRIC METER. It's perfectly legal. Save money. Details \$5.00. Western Research, Box 1061 PS, Woodland Hills, CA 91365.

CUT your utility bill, free details. PO Box 262, Oldsmar, Florida 33557.

REDUCE AIR CONDITIONING ELECTRICITY COSTS DRAMATICALLY! SIMPLE, INEXPENSIVE MODIFICATIONS-WINDOW OR CENTRAL UNITS. INFORMATION PACKAGE \$1.00. FLEMING ENGINEERING, REMSEN, NY 13438.

WINDMILL Electric Car, Engineer Drives To Work Free Or House Windmill. Plans \$5.00. Hadley, 2100 3rd Avenue, Seattle, WA 98121.

SAVE UP TO 34% ON COOLING COSTS WATER COOL YOUR CENTRAL AIR

Spraying Mantis
KIT from
PIERCE INDUSTRIES, INCORPORATED
P.O. BOX 26391 DEPT. PS
BIRMINGHAM ALABAMA 35226

- THERMOSTATICALLY CONTROLLED
- PRE-PROGRAMMED MIST
- SAFE, EASY INSTALLATION
- MASTERCARD/VISA HONORED
- MONEY-BACK GUARANTEE ONLY

\$129.95 Ppd.
Clip & Mail Ad for Free Info.

HYDROGEN — Electrolyzer Plans \$10.00. L. Spicer, Lineville, IA 50147.

HOME ENERGY INFLATION FIGHTER. Report analyzes alternatives using easily applied "Pay-Off" approach. Great \$5.00 value!! Write: "Enerviews", Dept. PS6, Box 150, Guelph, Ontario, N1H 6J8.

CEILING Fans buy at dealer prices. Send \$1.00 for catalog, Texas Ceiling Fans, Box 668, Carrollton, TX 75006.

SAVE ENERGY MONEY
MODIFY YOUR FORCED AIR GAS FURNACE
RECOVER 75% OF WASTE HEAT
This proven modification results in up to 15% savings in total fuel consumption.
Complete plans and instructions
Send only \$9.95 plus \$1.00 postage & handling to:
ENERGY RECOVERY SYSTEMS
6717 GALLEY RD. COLORADO SPRINGS CO. 80915

ENERGY SAVING \$200*
CALIFORNIA HOT TUB
DOUBLE-INSULATED-SOFTLINED
EASY TO BUILD
Only 32 simple saw cuts - no fancy joining or caulking. Foolproof construction. Most materials available locally or salvage from your workshop. Send just \$5.95 plus \$1.00 shipping and handling for complete plans, list of materials, sources, heating hints. *Tub Only, Est.
CALTUBS BOX 2650 SUNNYVALE, CA 94087

15B ALTERNATE ENERGY

HYDROGEN! — ACETYLENE! Super fuels. Complete directions, home manufacture. No special equipment needed. Hydrogen - \$2.00. Acetylene - \$2.00. Horizon Enterprises, Box 3334, Enfield, Connecticut 06082.

SOLAR Tubes - Hot water and heat. Build yourself, less than \$300.00. Plan \$4.95. Sun God, Rt. 3, Box 58A11, Pagosa Springs, CO 81147.

SOLAR cells .4V 4" diameter 2 amps \$8.75, 10 for \$85.00 plus shipping. Low power cells \$5.00. Foster, 1742 Dowd Drive, St. Louis, Missouri 63136, 314-522-6667.

SOLAR HOT WATER retrofit system - \$550. **PUMP/CONTROLLER** only - \$90. Send sase. F&M Solar, 2324 #9 So Highland, Las Vegas 89102.

SOLAR WATER HEATER. Make your own. Heats up to 5 gallons per hour. No complicated plumbing, complete plans, Parts list, \$4.95. Satisfaction Guaranteed. JRD Enterprises, Box 363, Oceanside, NY 11572.

PHOTOVOLTAIC (solar) Cells, Process Specifications, Instructions, Suppliers Directory, \$12.95. Vortex, Box 5633, Richardson, TX 75080.

25 UNIQUE WIND ENERGY SYSTEMS. Send \$10.00 to: **ENERWIND**, P.O. Box 6074, Arlington, VA 22206.

TRUE or False? 50 MPG carburetors. Box 206-8, Berea, KY 40403.

SOLAR HOME HEATING Simple, low cost, solar energy now. Construction plans \$5.00. Solarcraft Creations, 3227 W. Acapulco, Phoenix, AZ 85023.

SUNRUNNER INDUSTRIES INC. — DISCOVER US — Solar made easy and affordable. Right materials. Right price-write here. Include \$1.00 for catalog of our solar collector kits. Hot air systems etc. Box 51, Dept PS, Ogdensburg, NJ 07439. Dealers welcome.

GO SOLAR! I'll show you how. **FREE DETAILS!** Baes-4, 909 Eagle, Kingsford, Michigan 49801.

FREE ENERGY
Extract abundant free energy anywhere using permanent magnets. Know the truth! Plans, instructions, patents, and previously secret government report. Money back guarantee. Only: \$15.00
RESEARCH & DEVELOPMENT
P.O. Box 873
Concord, NC 28025

17 BURGLAR/FIRE ALARMS

PERSONAL SECURITY GUIDE. Don't be victimized! Learn from experts to protect yourself, loved ones and home. \$5.00. Leed Publications, Inc., Dept 12, Maplewood Drive, Townsend, MA 01469. Allow 4-6 weeks delivery.

TELEPHONE Dialer — \$16.00 Recorder Required. Davis, 4045 Redwing, Jackson, MS 39216.

"LIGHTED" HOUSE NUMBERS. 24 hr Protection **FREE** Brochure. Trimlite, Box 182-PS1, Sikeston, MO 63801.

21 HOBBIES/COLLECTIONS

COLLECT Military Medals. List 50c. Vernon. Box 387PS, Baldwin, NY 11510.

GROW AND COLLECT GIANT Crystals Free brochures. Crystocraft Company 10322 Schnapf Lane, Newburgh, Indiana 47630.

HAWAIIAN SHELLS, Coral. Price List \$1.00 Refundable With First Order. Box 442, Kailua, HI 96734.

25 FORMULAS, PLANS

20,000 MONEYMAKING FORMULAS CATALOG — \$2.00 — REFUNDABLE GWA6, Box 193, Brookfield, WI 53005

PENNY FORMULAS, 1,000. Easily Prepared Product Formulas. Send \$10.00 to: Nile, Box 3520, Nashua, NH 03061.

VERY OLD MANUFACTURES FORMULAS AND RECIPES, \$5.00. — Warling P.O. Box 99, Casstown, OH 45312.

26 SCIENCE & CHEMISTRY

CHEMICALS Laboratory Mining Apparatus Catalog \$1.00. The Chemical Shed, P.O. Box 748, San Bernardino, CA 92402.

CHEMICAL Apparatus. Lowest prices. Catalog one dollar. Avatar, P.O. Box 213, St. Charles, MO 63301.

NEW 200 Page 1981-82 catalog, listing thousands of chemicals, science equipment and labware. Send \$2.00 to: Merrell Scientific, 1665 Buffalo Road, Rochester, New York 14624.

CHEMICALS — Apparatus — Glassware. Catalogue \$1.00. Starr Scientific, 916 Madison Street, Manitowoc, Wisconsin 54220.

CHEMICALS apparatus, project books, wide selection. Catalog \$1.00. Send to: Pioneer Industries, 14A Hughey Street, Nashua, NH 03060.

LIVE IN LOS ANGELES? **CHEMICALS** Glassware Low Prices. Chem Lab Supplies, 1409 Hermosa Ave. Hermosa Beach, CA 90254. Call for info. 213-376-3430.

SCIENTIFIC Apparatus Catalog, 50c. Science Adventure, P.O. Box 11860 Winston-Salem, NC 27106.

GRAVITATION Association's **BREAKTHROUGH** Book, \$4.00. Refundable. 3204 Breeze, Austin, TX 78722.

27 PLASTICS

CASTOLITE Liquid Plastics. Crystal clear, colors. For casting, embedding, coating, fiberglassing; in industry, laboratories, craft work. Reproduce your designs with our mold materials. Profitable. Illustrated Catalog \$1.00. Castolite, Dept. 81G/PS, Box 391, Woodstock, IL 60098.

29 LOG CABIN & HOME BUILDING

UNDERGROUND HOMES BLUEPRINTS ONE floor \$8.00, two floors \$12.00, both \$18.00, **SPECIAL FEATURES,** Bedrock Homes, Box 2283, W Scarborough, Maine 04074.

32 REAL ESTATE

CALIFORNIA. Acreage. Lots. \$30 down. \$30 monthly. 4602 Ethel, Sherman Oaks, CA 91423.

WYOMING — UTAH RANCH LAND 10 Acres \$60.00 Down, \$60.00 Month Owner-Mike Gauthier, 9550-A Gallatin Downey, CA 90240.

BIG . . . FREE . . . SUMMER CATALOG LOGI Over 2,800 To Values Coast to Coast! **UNITED FARM AGENCY,** 612 PS West 47th, Kansas City, MO 64112

FREE! Big Summer Catalog! Over 5,400 country properties described, pictured! Land, Farms, Homes, Businesses, Recreation, Retirement buys! Select the best thruout the U.S. Over 700 offices in 43 states All Across America! Your **FREE** from the World's Largest **STROUT REALTY, Inc.,** 7-S, Dearborn Dept. 5810, Chicago, IL 60603.

FREE REAL ESTATE CATALOG Photos and descriptions of properties of every kind. Write **LAND MART OF AMERICA,** P.O. Box 2420, Dept. 2, Little Rock, AR 72203 or Call Toll Free (800) 643-8073.

GOVERNMENT LANDS — from \$7.5 Acre! "Buyer's Guide" . . . plus nationwide listings - \$2.00. Surplus Land Box 19107-FF, Washington, DC 20036

34 CAMPING EQUIPMENT & TENTS

FREE Catalog. Everything for Camping. Campmor, Box 407P, Bogota, NJ 07603.

BACKPACK/FRAME — BUILD YOUR OWN Plywood construction, light strong, attractive, inexpensive. Detail plans \$5.00. **PACKBAG,** detailed detail \$2.00. QRI, P.O. Box 200-PS, Lewburg, PA 17837.

34A SURVIVAL EQUIPMENT

NUCLEAR War Survival Book. Thousands already gone. \$6.00. Forns, Box 545, Newport, VT 05855.

35 AQUARIUM SUPPLIES

LIVE SEA HORSES \$3.98

Kit includes 4 adults & up to 30 ponies from pregnant male, marine salt, food, live plant, live snail & instructions. Above kit with Custom Aquarium, sea horse tree, seashells, coral, silica sand & 2 ghost shrimp \$7.95. Large Deluxe Aquarium with all custom kit accessories & 10 adult sea horses (2 preg. males - up to 60 sea horses) \$12.95. Kits sent ppd. Live delivery guaranteed. via air mail. Sea Horses, Inc. Dept. PS 61, Box 1477, Coral Gables, FL 33134

39 EARTHWORMS, CRICKETS, FROGS

FREE Literature. Raise Fishworms, Crickets, Red wigglers — 1000 — \$8.95, 5000 — \$42.50. Postpaid with free book on How and Where to Sell. Carter Farm — 12, Plains, GA 31780.

42 FIELD GLASSES, TELESCOPES

FREE Catalogue! Thousands War surplus optical bargains. Lenses, Prisms, Telescopes, Binoculars, etc. Jaegers, 691G Merrick Road, Lynbrook, NY 11563.

MX, Military Exchange. Countless ads monthly. Buy and sell everything military. \$6.00 for year's subscription. MX, P.O. Box 3, Dept. PS, Torrington, CT 06790.

43 GOV'T. SURPLUS

JEeps - \$19.30! - CARS - \$13.50! - 650,000 ITEMS! - GOVERNMENT SURPLUS - MOST COMPREHENSIVE DIRECTORY AVAILABLE TELLS HOW, WHERE TO BUY - YOUR AREA - \$2 - MONEYBACK GUARANTEE - "GOVERNMENT INFORMATION SERVICES," DEPARTMENT A-6, BOX 99249, SAN FRANCISCO, CALIFORNIA 94109.

JEeps - \$18.88. 675,000 Items! Be #1. Your Area! How! Where! "Money-back GUARANTEED 1981 GOVERNMENT SURPLUS Directory" including: "Buy G-LANDS," "G-Off/G-Gas LOTTERIES" \$3.00. **GSURPLUS**, Box 2009-C, Syracuse, NY 13220.

JEeps \$52.40. Airplanes \$75.01. Boats \$7.50, direct from government. Directory and Surplus Catalog \$2.00. Midwest Surplus, Box 401-PS, Dayton, Ohio 45401.

"GOVERNMENT SURPLUS Directory." Buy 500,000 items (including Jeeps) ... low as 2c on dollar ... direct from Government! \$2.00 (guaranteed). **DISPOSAL**, Box 19107-FF, WASHINGTON, DC 20036.

1981 SURPLUS Army, Navy store 64 page illustrated catalog. Send \$1.00. Ruvel, 3037 North Clark, Dept. M6, Chicago, IL 60657.

45 BODY-BUILDING, SELF-DEFENSE COURSE

BODY BUILDING - A Complete Step By Step Daily Guide. Build Entire Body With Maximum Results \$4.95. Concept, 120 Alladin St., Greenville, SC 29609.

46 PROFITABLE OCCUPATIONS

REPAIR Lawnmowers - wholesale list 35c, no stamps. Ellwanger's, 15 Canal, Port Jervis, NY 12771.

SURPRISE Everybody. Become Notary Public now. We guide you, free. We sell notary needs. Raise your image, job value, income. Assistance nationwide. Brochure: Gulf, 234 Club-B, San Antonio, TX 78201.

FREE Catalog. Repair Air Conditioning, Refrigeration. Tools, supplies, full instructions. Doolin, 2016 Canton, Dallas, TX 75201.

PROSPECTING Could Change Your Life! My booklet will help you plan, pan, camp, test for gold and fool's gold and much more. Send \$5.50 to: G&G Publications, Box 1867-PS, San Antonio, CA 92702. Act now, the new gold rush is on!

MECHANICALLY INCLINED INDIVIDUALS

Assemble electronic devices in your home. Knowledge or experience not necessary. Get started in spare time. Above average profits. \$300-\$600/wk. possible. Sales handled by others. No investment - Write for free details.

ELECTRONIC DEVELOPMENT LAB
Box 1560G, Pinellas Park, FL 33565

\$8.00 - \$15.00/HOUR IN DRAFTING Confidential Report \$5.00. Money back guarantee. Rhodes Press, Dept PSI, 819 W. Beacon Rd., Lakeland, FL 33803.

47 BOOKS & MAGAZINES

OUT-of-Print Books Found. Send Wants. Booklook, 51 Maple Ave., Warwick, NY 10990.

GUIDE TO OVER 400 MONEY-MAKING HOW-TO BOOKS

GUIDE TO OVER 400 Money-Saving. Money-making HOW-TO BOOKS. each described. 17 categories 1st & only book of its kind. Invaluable inflation fighter. **ONLY \$9.95 p.pd.** **MONITOR MARKETING.** Dept PS. Box 682. Syosset. N.Y. 11791

49 JOKES & NOVELTIES

YOUR PICTURE MOUNTED on large pin-on button. Send \$1.00 & snapshot. Phenix Enterprises, 1900 East Warner No. N, Santa Ana, CA 92705.

FREE—World's Leading Novelty Catalog. 1600 Jokes, Tricks, Science, Sports, Hobbies, Johnson-Smith, C-11, Mt. Clemens, MI 48043.

50 MAGIC TRICKS, PUZZLES, ETC.

FREE! \$2.00 Trick, huge catalog, both \$1.00. Abracadabra-SP, Scotch Plains, New Jersey 07076.

PROFESSIONAL Magic! Huge catalog, over 1,000 tricks and books. \$2.50. Hank Lee's Magic Factory, Dept. PS6, 24 Lincoln Street, Boston, MA 02111.

51 COINS & CURRENCY

MAKE Big Money! Buying Gold, Silver in your neighborhood. Money-making Instruction Manual! \$3.00. **TESTORS**, 612 South Hawley, Milwaukee, 53214.

52 STAMP COLLECTING

U.N. 8 mint sets \$1.00! Approvals. Gordon Davison, Contoocook, NH 03229.

GREAT U.S. Free Gift - Fine U.S. approvals and want list service. - Send 25c for handling. The Stamp Boutique, Box 86S, Wheeling, IL 60090.

FREE LIST U.S. Mint Singles, Plates, Accessories. No Approvals. Stamps, Box 66, Coram, NY 11727.

50 DIFFERENT Old U.S. between 1861 and 1939 \$1.00. Ed Roush, 423 Shepard, Mansfield, OH 44907.

UNITED NATIONS 3 Complete Mint Sets 25c. Approvals. Cornetta, POB 1509-P, Lake Placid, FL 33852.

PENNY Approvals! Regardless Catalogue! Kloster, 4164—52nd Street, San Diego, CA 92105.

FREE Surprise collection sent with approvals. Jay, 1784 Union, San Francisco 94123.

WORLDWIDE COLLECTION - 100 different stamps - only 10c with fantastic worldwide approvals. Nazlo, Box 423-OE, Audubon, PA 19407.

2,000,000 STAMPS - 150 countries 2c each, Belden, Box 4149, Dearborn, 48126.

OLD U.S. Stamps on approval. Chester, Box 15355R, Philadelphia, PA 19111.

500 LITHUANIA, Estonia, Latvia, Ukraine. Five Dollars. Kieve, 173 Linden, Middletown, NY 10940.

50 YEARS Old, fifteen different United States, over fifty years old 25c with approvals. Jaxon, Box C11, New Rochelle, NY 10804.

FREE Worldwide packet. Penny approvals. Froelich, Box 412-B, Morton Grove, IL 60053.

BARGAIN 20 U.S. Over 40 Years Old 10c. Quality World Wide Approvals. Larson, Box 886, Alamo, CA 94507.

3 FOREIGN Sets 30c. Approvals, Discounts, Special Offers. R.G. Sales, Box 1065, Jamaica, NY 11431.

TOPS! 100 Popular Poland Stamps (All Different) Only 25c. Mystic, Dept. PS2, Camden, NY 13316.

FREE! Big Bargain Catalog — New Edition listing thousands of bargains including U.S. & B.N.A. stamps, packets, albums, accessories and supplies. Also, fine stamps from our approval service, buy any or none, return promptly, please. Jamestown Stamp, Dept. E61PS, Jamestown, NY 14701.

U.S. STAMPS. 1893 Columbian Exposition, early bicolor airmail, Pony Express Commemorative, Olympics Issue. Plus more. 10c with approvals. HSM, Box 239, Dept. S-6, Fullerton, CA 92632.

54 RADIO, TELEVISION

RECEIVE FREE Uninterrupted movies, sports, shows with your own **AMATEUR MICROWAVE SUBSCRIPTION TV ANTENNA.** Build yourself, complete plans. Fully guaranteed or full refund. \$9.95. Phillips-Tech Electronics, Dept. SP-2, 5025 North 68th Street, Scottsdale, AZ 85253.

CABLE TV DECRYPTERS AND CONVERTERS. MICROWAVE ANTENNAS AND DOWNCONVERTERS. Plans and Parts. Build or buy. For information send \$2.00. C&D Company, P.O. Box 21, Jenison, MI 49428.

POLICE Scanners, Crystals, Radar Detectors. HPR, Box 19224, Denver, CO 80219.

36c TUBES. Radio & TV! Free Color Catalog. Cornell, 4217S University, San Diego, CA 92105.

PICTURE Tubes remanufactured color picture tubes from \$33.00 2 year guarantee for complete list. Send \$3.00 to: National Picture Tubes, P.O. Box 601, Ogallala, NE 69153.

VIDEO Cassette Rentals And Sales. All ratings. 20/20 Video, Box 6162, Chicago, IL 60680.

RADIOTELETYPE PRESS SERVICES Fascinating world news from 50 confidential news services. **UPI, AP, REUTERS**, all countries; Hundreds of frequencies; how to receive, complete manual; \$5.95 - Universal Electronics, 1280 Alda, Reynoldsburg, Ohio 43068.

SUBSCRIPTION TV, COMPLETE 2300MHz MICROWAVE ANTENNA SYSTEM. \$279.95. Plans, \$9.95 refundable on antenna purchase. More information send SASE to **BEAT THE SYSTEM**, DynaComp Electronics, POB 4181, Scottsdale, AZ 85258. (602) 941-9395.

55 ELECTRONICS, STEREO, HI-FI

LINEARS - Send Stamp For Details - Matco Electronics - Box 316D - Cadillac, MI 49601.

LINEAR PLANS, parts, GOODIES. Free catalog. "SKIPPER", Box 130-C6, Paradise, CA 95969.



BUILD AN ORCHESTRA THE WERSI WAY

Preview the world's most advanced Do-It-Yourself Organs, Pianos, Synthesizers, Amps, etc. Send \$6.00 for our famous "Sight & Sound" pack.

WERSI Electronics, Inc., Dept. M3,
P.O. Box 5318, 1720 Hempstead Rd., Lancaster, PA 17601.



30 CHANNEL CABLE TV CONVERTER

39.95

ORDER No. 175AE047

FREE! UNUSUAL 96 PAGE ELECTRONIC PARTS & IDEAS CATALOG!

PLATTSBURGH, N.Y. 12901
Tel.: (516) 961-8700.

★ **SEND FOR FREE** ★

★ **36 PAGE** ★

★ **ELECTRONIC PARTS** ★

★ **CATALOG** ★

★ **OVER 1000 ITEMS** ★

ALL ELECTRONICS CORP.

905x S. Vermont Ave. Los Angeles, CA (213) 380-8000 90006

56 RECORDS, TAPES, etc.

OLD Radio Programs On Cassettes. Free Catalog. Nostalgic, Box 16365-P, St. Louis, MO 63125.

BLANK RECORDING TAPE BARGAINS! Catalog 25c. Tower, 213S, Dunkirk, MD 20754.

PREMIUM audio cassettes. Agfa tape Wholesale price list available. Solid-sound, Box 7611, Ann Arbor, MI 48107.

57 MUSICAL INSTRUMENTS

DULCIMERS Kits From \$35.00. Brochure. Here Inc., 29 Southeast Main, #S, Minneapolis, MN 55414.

VIOLIN, Guitar, Banjo, Mandolin Making Materials. Accessories. Books. Piano Tuning Kits. Catalog \$1.00. International Luthiers Supply, Box 15444, Tulsa, OK 74112.

INTERNATIONAL Catalog valuable to makers, repairers of stringed instruments. Imported woods, parts, accessories, kits. Fine German-made violins, violas, cellos, basses and bows. Send 25c for catalog. 10% Credit certificate will be enclosed. International Violin Company, Ltd., Dept. MP, 4026 W. Belvedere Ave., Baltimore, MD 21215.

FINEST FOLK FLUTES. Plans, instructions or completed instrument. Eternal Enterprises, Box 60913M, Sacramento, CA 95860.

SAVE ON ACCORDIONS



40 Models! Famous Make SAVE! Direct from Importers. Models for students, teachers, professionals. Standard or Electronic. Terms. Trade welcome. Home Trial. Holin Button models too. FREE catalog and importer price.

ACCORDION CORPORATION

5535 (PX) Belmont Avenue, Chicago, Ill. 6064

57A MUSICAL INSTRUCTION

PLAY MUSIC BETTER through understanding Chords as used in creation of "musical ideas". **FREE INFORMATION** - Music Learning Systems Publishing, Dept 11PS, RD3, Box 142 Olean, NY 14760.

58 SONG WRITERS

POEMS - SONGS WANTED. Free Publishing/Promotions. Broadway Music Box 7438-PS, Sarasota, FL 33578.

POEMS set to music. Nashville Music Productions, Box 40001-PS, Nashville TN 37204.

59 IMPORT-EXPORT

2500 "Fast" Sellers. Free Brochures. Brighton, Box 91309-X6, Cleveland, OH 44101

60 BUSINESS OPPORTUNITIES

DIRECT DISTRIBUTORS WANTED! Former Shaklee President Announces New Opportunity. Free Details! (612) 588-1957. Enhance, Box 22726-PS Robbinsdale, Minnesota 55422.

BUMPERSTICKER Printer Easy Fun. Details. POB 22791 (LLC), Tampa FL 33622.

LOW Investment-High Income Businesses. Business Guides, 3347 SE Belmont, Box 10, Portland, OR 97214.

FREE SAMPLE. Graphic studio seeks mail order distributors. Beginner's welcome. Graphic International, 87 Pettibone Square, Scarborough, Ontario, Canada M1W 2J1.

SYNTHETIC OIL DEALERS Needed. Exciting Products & Opportunities. Make More Spare Time Than in Present Business or Job. Call: 800-835-3342.

REPAIR HYDRAULIC JACKS—Free details. Hydraulic Parts Supply, Dept. S, Box 4157, Brownsville, TX 78520.

\$92.00 FROM Square Foot Plywood (Huge Demand). Revealing Proof 25c (Refundable). Woodwins, Bridgewater, MA 02324.

GET RICH!! Secret law smashes debts —brings cash and credit! Details **FREE!!** WealthKit-S, Billings, NY 12510.

HUNDREDS WEEKLY POSSIBLE! MAILING PROGRAM: Nationwide, Box 58806, Dallas, TX 75258.

WIN at Dice! 582 to 1 odds your favor! Free Proof. Baker, Box 196B, Brooklyn, NY 11218.

VENDING Machine. No selling. Routes earn amazing profits. Big Catalogue Free. Parkway Corporation, 1930PSB Greenspring Drive, Timonium, Maryland 21093.

FREE Inflation-Beater Book "2042 Unique, Proven Enterprises." Fabulous "Little Knowns." Work Home! Haylings-E, Carlsbad, CA 92008.

FREE Mailorder Dropship Business Journal! Mailer's World, Box 1355-P, Sioux Falls, SD 57101.

PIANO Tuning learned quickly at home! Free information. Empire School, Box 1014, Jupiter, Florida 33458.

LEARN TO REFINER YOUR GOLD • SILVER • PLATINUM STEP By Step Home Method. Also Testing Precious Metals For Value \$14.50. The Silver Palace Precious Metal Refinery, 8064 Melrose Ave., Los Angeles, CA 90046.

MAKE \$2,000.00 Monthly Spare Time. Unique proven enterprise. No selling. No capital to start. Free brochure. Kashbuilder, Box 1132-PK, Indianapolis, IN 46225.

BELTS And Buckles. Complete Line Fast Sellers, including Westerns, Truckers, Motorcycles, Wildlife, etc. Big Profits. Complete dealer set up. Free Catalog. Anchor, Box 3958-BPS, North Providence, RI 02911.

PIANO Tuning quickly learned with home study course. Diploma granted. American Tuning School, 17050 Telfer Drive, Morgan Hill, CA 95037.

NEW Tax Loopholes Discovered. Everyone eligible. Free Sample Newsletter. Write: ULC, Box 179-00, Clarkston, GA 30021.

\$500 - \$1000 MONTH Plan raising bits for us. Free details, White's bbitry, PS, Hudson, OH 44236.

MECHANICALLY inclined individuals siring High Weekly Profits operating all Manufacturing business Without vestment write: Businesses, 92-P ighton 11th, Brooklyn, NY 11235.

DO YOU have a product or service to ll by mail? Then you should be adver- ing in this powerful, result getting **CLASSIFIED ADVERTISING OPPOR- NITY** section, where over 4 1/2 million aders shop each month. See page 138 r rates and the next available issue.

SOLAR/Woodburning Dealers Needed untapped market, ground floor, In- mation \$3.00. Solar, 44066, Atlanta, A 30336. 404/691-1960.

SILVER RECOVERY - Millions of dol- rs of Silver being dumped into the wers. Yours free for asking - Complete formation - \$3.00 - LCIP, P.O. Draw- 341, Lake City, PA 16423.

DISTRIBUTOR URGENTLY NEEDED! ormer Shaklee President announces EW opportunity. Free details! Enhance, 305 West Highland Drive, Burnsville, N 55337. (612) 890-9237.

HUNDREDS weekly in mail order ome operated Free Details. Turbett As- sociates, Box 26PS7, Baltimore, OH 3105.

105 PROFITABLE WAYS TO MAKE- ONEY AT HOME! Simple, innovative eas any one can implement. Illustrated ook \$3.00 (Details Free). Vic Preston, 11-E Glenwood, Buffalo, New York 4208.

SYNTHETIC Oil Dealers Needed. Ser- us, Lucrative, Part-time Business. Write: Pat Allen, 120 Richardson Dr., ort Dover, Ont., NOA 1N0

INTERNATIONAL BUSINESS OPPOR- NITY. Profits world-wide, your own business from home, without capital, experience. Details **FREE!** Resource Corporation, Box 4667C, Philadelphia, PA 19127.

MAILORDER Opportunity! Start profit- able home business without experience or capital. Information free. Mail Order Associates, Dept. 732, Montvale, NJ 07645.

BIG Money selling information by mail! Unique plan. National Mailers, Box 3772, S Hialeah, FL 33014.

PREPARE Tax Returns - Housewife Jo Ann Netzler made \$5,500 last sea- son. VA approved. National Tax Train- ing School, Monsey, 1FN, New York 10952.

WHOLESALE'S GIANT CATALOG, \$3.00. **MERCER'S**, 12214-F Spiney Ridge, Jacksonville, FL 32225.

50 FANTASTIC Money-Making Re- ports! Reprint-Resell, 100% Profit! Fi- nancial Opportunities, Dept. 1-AA, 8753 Windom Avenue, St. Louis, MO 63114.

GOLD AND SILVER REFINER. Com- plete Plans and Specifications. Com- mercial Electrolytic Method - .999 Pure. Only \$10.00. R&D Engineering, P.O. Box 408, Union, MI 49130.

HOME BUSINESS. Profitable Manu- facturing, Detergents, Polishes, Clean- ers, Specialty Products. Complete Formulas! Chemical Specialties O2C6, East Providence, RI 02914.

BABY SHOES. Bronze, Porcelanize. Big Money home business! Inexpensive kits, company assistance. Metalcraft O2E6, East Providence, RI 02914.

MONEY SECRETS HELP people and businesses get mon- ey. Easy home business. Fantastic prof- its. No experience - own hours. Con- tinuous assistance. Free Details: DFC, Dept. 11-G-6, 1145 Reservoir Avenue, Cranston, Rhode Island 02920.

SELL SENSATIONAL LOW-COST BURGLAR ALARM. Lightning seller. Ex- ceptional margin. Samples for trial. Northwest Electric, Ave. 166, Mitchell, SD 57301.

IMPORT-EXPORT opportunity. profit- able world-wide, mail order business from home, without capital. We ship plan for no risk examination. Experience unnecessary. Free Report. Mellinger, Dept. M2696, Woodland Hills, CA 91367.

I HAVE MADE A FORTUNE IN MAIL- ORDER, selling information! Let me show you how. **FREE** proof. Mailorder Information Services, 2385 Roscomare, D-11/156, Los Angeles, California 90024.

SELLING KNAPP SHOES IS EASY. Highest cash commissions immediately. Enjoy a steady income with satisfied repeat customers. Your own hours. No investment. Free selling and training kit to qualified applicants. Write: John Learnard, Knapp Shoes, 5109 Knapp Centre, Brockton, MA 02401.

TAKE Catalog Orders. We dropship 2500 Best-selling specialty products. Lowest below-wholesale prices. Imme- diate delivery. Spectacular home busi- ness opportunity. Free Book. SMC, 6061 De Soto Ave., Dept. 28-06, Woodland Hills, CA 91365.

DISTRIBUTORS, Immediate Cash Prof- its! Revolutionary Automotive Bargain. Free Details. Motaloy, Box 4457S6, Downey, CA 90241.

PLASTERCRAFT! Moneymaking home business. Details. Mailway, 24949-EF6, Nashville, TN 37202.

BIG PROFITS ELECTRONIC ASSEMBLY BUSINESS

Start home, spare time. Investment, knowledge or experience unnecessary. **BIG DEMAND** assembling electronic devices. Sales handled by professionals. Unusual business opportunity.

FREE: Complete illustrated literature
BARTA, Box 248-SS
Walnut Creek, Calif. 94597

ENHANCE, A GROUND FLOOR OPPORTUNITY!

Dynamic new marketing company, founded by former President of Shaklee Corp., is looking for experienced sales leaders to become **FOUND- ING SPONSORS**. Outstanding marketing pro- gram. **FREE** information.

ENHANCE MARKETING, Box 552-PS, Fort Payne, AL 35967 Tel. (205) 845-4732

BUMPER STICKER PRINTING DEVICE

FUN, INEXPENSIVE, PORTABLE. EASY - NO TRAINING NEEDED. ANY MESSAGE IN MINUTES. Get FREE DETAILS. P. O. BOX 22791 (LL), TAMPA, FLA. 33622.

61 MONEYMAKING OPPORTUNITIES

THOUSANDS in mailorder home oper- ated. Free details. J/M Enterprises, Box 272-PS7, Pickerington, OH 43147.

\$56.40 DAILY Starting next week. Details send 18c poststamp: Sbiatox, Box 4308, North Hollywood, CA 91607.

\$500.00 WEEKLY mailing Science Books for corporations from home! (Guaranteed Program!!) Details — Tribune PS-6c, Box 18553, Wichita, KS 67218.

PLASTERCRAFT — Profitable Home Business. Over 1,000 molds available. Details: Lynnette, 6251R Mentor Park, Mentor, OH 44060.

EARN Money From Home! Immedi- ately! Write: Dayp, Box 89, Licking, MO 65542.

CASH In At Flea Markets! This item always best seller. Complete Report contains Supply Sources. Methods. More!! \$5.00. Roger Lacroix, Box 612A, St. Johnsbury, VT 05819.

EXTRA MONEY! How - to Make Money in Your Spare Time! Copyrighted Report!! \$2.00 Satisfaction Guar- anteed!! Johnston House, Dept. PS-6, 8546 Riverview, St. Louis, MO 63147.

DEBTS WIPED OUT with secret Fed- eral Law!! Fortune-building **FREE RE- PORT!!** Blueprints, S6, LaGrangeville, NY 12540.

LEARN The Secrets of Repairing Junk Batteries. "Fabulous Profits", small in- vestment. Apex Engineering, 5454 Bolsa Road, Atascadero, CA 93422.

NEW Discovery in Battery Recondi- tioning. Eighteen Months Guarantee Means "Big Profits Fast." Electroan, 7415 Gable Drive, Little Rock, AR 72205.

GET RICH!! Secret law smashes debts - - - brings Cash, credit! **FREE** report!! WealthKit-S, Billings, NY 12510.

NEED MORE MONEY? Examine over 1,000 ways to earn it full time, spare time, part time on weekends! Get 5 issues of Opportunity Magazine Free! Write: Opportunity, Dept. 604, 6 N. Michigan, Chicago 60602.

WIN BIG OIL MONEY

Plus Tax Benefits

The U.S. Government sponsors a little-known oil and gas lease drawing. If you are a U.S. citizen, you can compete for a fortune in oil. A \$30 (tax deduct- ible) filing fee could bring you \$100,000 immediately, plus possible payments. For free information Call Toll-Free 1-800- 525-2541, Ext. 8, in Colorado Call Collect 1-447-1399, Ext. 8, Or Write . . .

F. Milligan, Inc.
1942 20th St., Drawer 3408PS
Boulder, CO. 80307

62 EMPLOYMENT INFORMATION

JOBS Overseas-Big Money Fast. \$20,000 to \$50,000 plus per year. Call 716-842-6000, Ext. 4008.

AUSTRALIA - New Zealand! Big pay! 50,000 jobs. Free transportation. List- ings \$2.00. Information 68 countries. Austco, Box 772, Cypress, CA 90630.

OVERSEAS . . . \$20,000 - \$60,000 + . Free Report! Employment, Box 29217- FF, Indianapolis, IN 46229.

WORK week on, week off. Gulf coast offshore oilfields. Men, women, skilled, unskilled. Salary justifies long distance commuting. Details \$5.00. UNCO, Box 17103, Pensacola, FL 32522.

BACKPACKERS, earn \$1200. month enjoyably! Information \$3.00. Wilder- ness Expeditions, 473 Oakwood Ave., #310V, Toronto, Canada M6E 4Z2.

62A HELP WANTED

\$180 Per Week Part Time at Home. Webster, America's foremost dictionary company needs home workers to update local mailing lists. All ages, experience unnecessary. Call 1-716-845-5670 Ext. 3012.

63 SPECIAL SERVICES

INFORMATION On Anything. Ferguson Research Specialists, 60-15 Woodside Avenue, Woodside, NY 11377.

67 SALESPERSONS— DISTRIBUTORS WANTED

FREE Sample! Full size Miracle Clean- ing/Polishing Cloth! \$1.79 seller pays 542% profit! Terrific demonstrator. Every surface sparkles in seconds. Ex- clusive territory. Send 25c sample post- age. Barry, Dept. 6361, 1312 Washing- ton, St. Louis, MO 63103.

40% COMMISSION. Quality Mag- netic Science. Established Company. Details: 1344 Hornblend, San Diego, CA 92109.

68 REMAILING SERVICES

SANTA ANA California Remails. AVEC, PS61, Box 11491, Santa Ana, CA 92711.

69 CONTESTS

\$100,000 CASH & Prize Certificates! Skill Contest. Send 25c For Details. NHHE, Box 3948, Kingsport, TN 37664.

70 AUTHOR'S SERVICE

PUBLISH YOUR BOOK! Join our successful authors. Publicity, advertis- ing, beautiful books. All subjects invit- ed. Send for fact-filled booklet and free manuscript report. Carlton Press, Dept. PSQ, 84 Fifth Avenue, New York 10011.

72 EDUCATION & INSTRUCTION

VETERINARY Assistant - Train at home for exciting animal-care career. Send for Free "Career Kit." North Amer- ican School of Animal Sciences, Dept. PCC41, Newport Beach, CA 92660.

MEMORY, Sleep Learning. Free Pub- lication. DLP, Box 487, Anaheim, CA 92805.

FREE! "NEW CAREER OPPORTUNI- TIES IN JET/GAS TURBINE POWER!" Plus Home-study course outlines for mechanically inclined — American Jet School, Dept. PS-2, Darby, Montana 59829, 1-800-547-5995, Ext. 126.

DRAFTING is a great career! Men, women. No previous experience or spe- cial talent needed. We train you at home in spare time. Get free facts. Write: North American School of Draft- ing, Dept. PCC41, 4500 Campus, New- port Beach, CA 92660.

EARN Extension Degrees in Homoeo- pathy, Radionics, Botanic Medicine, Na- turopathy, Philosophy, Psychology, etc. School Founded 1961. Prospectus \$1.00. Airmailed. Secretary PA/PS, Brantridge Forest School, Highfield, Danehill, Sussex, England RH17 7EX.

DEGREES, Thesis Method. Brochure, \$1. North, Box 3388, Tulsa, OK 74101.

MEDICAL ELECTRONICS TECHNOL- OGY. Home study. Troubleshoot Medical Instruments. MDC-PS, P.O. Box 124, Pinedale, CA 93650.

BARTENDING — Bar Management Home Study. Bartending Training, 3843- G San Fernando Road, Glendale, CA 91204.

REISCH WORLD WIDE COLLEGE OF AUCTIONEERING, INC., World's Larg- est. Free Catalog. Approved for VA. Modern Auction Library "FREE" with enrollment. 515-423-5242, Col. Gordon E. Taylor, P.O. Box 949, Dept. 3, Mason City, IA 50401.

LEARN Dowsing, Radionics, Radies- thesia and E.S.P. Subjects. Free Illus- trated Catalog. Courses and Equipment. (Airmailed \$2.00.) Established 30 Years: Bruce Copen, Highfield, Danehill, Sussex, England RH17 7EX.

LEARN WHILE ASLEEP! Astonishing New Method! Strange Catalog Free! Au- tosuggestion, Box 24-A, Olympia, WA 98507.

FREE Lifetime Ordination. Become Chaplain, Missionary Evangelist, Bishop. Box 744-PS, McKeesport, PA 15134.

ELECTRONICS Degree (BSET) by cor- respondence. Grantham College, 2500 La Cienega, Los Angeles, CA 90034.

SCIENTIFIC ASTROLOGICAL Courses. Write: Eternal Enterprises, Box 69913M, Sacramento, CA 95860.

FINISH HIGH SCHOOL AT HOME!

Diploma in just 6 months. Lessons by mail. Free school ring. Individual counseling. Low tuition/only \$49.00 down. Master Card/VISA. Call free 1-800-327-8103. Cambridge Academy PS-6, 1553 N.E. Arch Ave., Jensen Beach, FL 33457.

LEARN How To Form, Finance, and Operate virtually any type business. Send \$3.00 to: Information, Box 11215B, Fort Worth, TX 76110.

WELDING TRAINING. Basic and Ad- vanced for Major Processes — Arc (Stick), MIG, TIG, Gas. Pipe all pro- cesses. A non-profit school. Approved for eligible veterans. Accredited mem- bers **NATTS**. Approved Ohio 70-12-004 HT. Write for school bulletin and course schedule. **HOBART SCHOOL OF WELDING TECHNOLOGY**, Box 81, Troy, OH 45373.

COLLEGE DEGREES!

OVER 150 faculty members nation- wide. Bachelor's, Master's and Doctoral Degree Programs. Independent home study/private telephone tutoring. Cred- its awarded for work/life experience. Accredited by National Accreditation Assn. Free academic evaluation. **TOLL-FREE** 1-800-327-7006. North American University PS-6, 1277 E. Missouri St., Phoenix, AZ 85014.

UNIVERSITY DEGREES! No Classes, Fast, Economical. Accredited. **FREE** Re- vealing Details. Success, Box 13151- S6, Columbus, OH 43213

UNIVERSITY DEGREES BY MAIL! Bachelors, Masters, PH.D.s . . . Free re- vealing details. Counseling, Box 389- PS6, Tustin, CA 92680.

HIGH SCHOOL at home, no classes. Diploma awarded, low cost. Informa- tion **FREE**, call toll free anytime 1-800- 621-5809 (Illinois 800-972-5858) or write American School, Dept. 30647, 850 E. 58th St., Chicago, IL 60637. Give last year High School completed.

CLOCK AND WATCH REPAIR books. Free catalog. North American, Box 77BFA, Fox River Grove, Illinois 60021.

INSTANT MEMORY

The new way to remember
A short, simple method of acquiring a powerful memory. No memorization, no keywords. Release your photographic memory. Learn "how" you remember, "why" you forget. Discover your natural ability to recall everything. Send for free information to:
INSTITUTE of ADVANCED THINKING
845PS ViaLaPaz, Pacific Palisades, CA 90272

73 CARTOONING, SIGN PAINTING

LEARN Sign Painting—Free Cata- logue. Kaufmann Supply, Centertown, MO 65023.

MODERN Cartooning Taught by Mail. Write for Free Brochure. Cartoonrama, Box 263-IY, Branford, CT 06405.

CARTOON for Fun and Money!!! Free booklet!! Cartoons, Box 40614B, De- troit, Michigan 48240.

76 DETECTIVES

FINGERPRINTING - exciting scien- tific career. Home study course teaches everything. Certificate on completion. Many openings; prepare now. Profes- sional Investigators Training School Dept. FP, P.O. Box 41256, Los Angeles CA 90041.

DETECTIVE Profession, easy home study; free tie-tack or lapel pin, certifi- cate, future. Professional Investigator Training School, Dept. CB, P.O. Bo 41256, Los Angeles, CA 90041.

77 LOANS BY MAIL

IMMEDIATE Loans to deserving in- dividuals refused elsewhere. Many plan included. Try us! Associates, Box 98-P3 Brooklyn, NY 11235.

QUICK \$Cash\$ Signature Loans Write: Elite, Box 454-PS, Lynbrook New York 11563.

BORROW \$30,000 without interest All eligible. Repay anytime. Free de- tails. Infohouse, Box 1004-PS6, New York, NY 10003.

BORROW \$20,000 "Immediately" Keep Indefinitely. Pay Interest Only HPE, 1619 Avocado, Melbourne, F 32935.

BORROW \$25,000 "overnight." An- purpose. Keep indefinitely! Free Report Success Research, Box 29070-FF, In- dianapolis, Indiana 46229.

BORROW By Mail! Free Details! MBO PS681, Box 2298, Sandusky, OH 44870

BORROW FROM HOME ANY amount, any worthwhile pu- pose, within 30 days. Competitive Rate Also, you can earn substantial incom- as a Money Agent. No experience - ow hours. National Company to assist eve- way possible. No Gimmicks! Free Detail DFC, Dept. 11-C-6, 1145 Reserv- Avenue, Cranston, Rhode Island 0292

QUICK MAILLOANS! Fast, free detail Lenco, 240-P6 Kingwood, McMinnvill Oregon 97128.

78 WINEMAKING

WINEMAKERS—BEERMAKERS Free Catalog. Fast Service. Large Selection. Kraus, Box 7850-N, Independence, MO 64053.

BREW finest beer from quality ingredients. Free catalogue. Bacchanalia, Box 51PS, Central Village, MA 02790.

FREE ENCYCLOPEDIA WINEMAKING BEERMAKING, supplies, equipment, ingredients. Vynox Industries, Box S7498, Rochester, NY 14615.

WINEMAKERS - BEERMAKERS — Fresh Stocks, Fast Service. Free Catalog. O'Brien's, Box 284A, Wayne, IL 60184.

WINEMAKERS — BEERMAKERS — GASOLIN. Free Catalog. Equipment Supplies. Continental, Box 68016-PS, Indianapolis, IN 46268.

CATALOG. Finest equipment, ingredients, Fully guaranteed. SPI, Box 784-S, Chapel Hill, NC 27514.

WINEMAKERS - Beermakers: Free Illustrated catalog of supplies. Semplex, P.O. Box 12276H, Minneapolis, MN 55412.

COFFEE LIQUEUR - Make your own for \$3.00/qt. Absolutely delicious. No special tools. Send \$3.00 to: Tyson, 12806 Midway #1030, Dallas, TX 75234.

BEERMAKING Supplies . . . World's Largest . . . Free Catalogue. Bierhaus, Box 8376-CC, Erie, Pennsylvania 16505.

BEERMAKERS Catalog/Newsletter. Free! William's Brewing, Box 461-P6, Oakland, California 94604.

79 BUY IT WHOLESALE

400,000 BARGAINS Below Wholesale! Many Free! Liquidations . . . Closeouts! . . . Job Lots . . . Single Samples. Free details. Worldwide Bargainhunters, Box 730-B, Holland, MI 49423.

REPLACEMENT PARTS for Chainsaw, motorcycle, snowmobile, small engines. Energy saving items. Wholesale prices. Free catalog. Manufacturer's Supply, Box 157PS5, Dorchester, WI 54425.

WHOLESALE discounts to 35%. Brandnames; Makita tools; Ariens rear-end tillers; Victor welding supplies; John Deere log splitters, chainsaws, air-compressors, pumps, mowers, etc.; Atlantic Steel buildings; Catalogue \$1.00, refundable; AES, Box 1790S, Fort Bragg, CA 95437.

85 PRINTING & RUBBER STAMP OUTFITS

PRINT YOUR OWN — Printing Presses. Type. Supplies Direct From Factory. Send 25c for Catalog and Samples to: Jersey Company, DS, Meriden, CT 06450.

7 TOBACCO, PIPES, CIGARS

AZTEC South American Gold Pipe tobacco. Mild Aromatic. Different! Send \$1.00 For Sample. Smoker's Inn, 3301 W. Central, Toledo, OH 43606.

8 OLD GOLD, JEWELRY WANTED

HIGHEST CASH IMMEDIATELY for Old Gold, Silver, Platinum, Jewelry, Old Teeth, Watches, Diamonds, Spectacles. Free Information. Rose Industries, 29-Y East Madison, Chicago, IL 60602. Established 1934.

HIGHEST CASH IMMEDIATELY, guaranteed, for broken gold teeth, jewelry, coins, rings, spectacles, watches, pre-1965 silver coins. Mail today. Solek Metals, Box PS1472, St. Petersburg, Florida 33731.

HIGHEST CASH for Gold, Jewelry, Old Teeth, Rings, Diamonds, Watches, Silver, Platinum, Mail Attricles Today. Free gift with Information. Chicago Gold & Precious Metals, 6 E. Monroe, Dept. 1057, Chicago 60603.

9 WATCHES, CLOCKS—SALES & SERVICE

WATCH and Clock Repairing Books, Tools, Materials. Free Catalogs. North American, Box 77-BF, Fox River Grove, IL 60021.

1 OF INTEREST TO ALL

NEED CREDIT? Get Visa, Master Charge Card — with no credit check. Guaranteed! It's simple. Legal. Plus other credit secrets. Free details! Send A.S.E. to: Inflation Reports, PS-A, D, Box 60148, Los Angeles, CA 90060.

"BUYING" or "SELLING" through classified ads?? You need our instructions, easy to ready guide!! \$3.00. Associates International, Box 388, Garden City, MI 48135.

CANKOR SORE RELIEF, How to relieve and avoid them \$3.00 Sase. P.O. Box 187, Escanaba, MI 49829.

DIKING HIKER Send \$12.00 For A Pollution Analysis. Postage-Paid Mailer Provided. EPA Certified. A-B-E Labs., Box 2847, Allentown, PA 18001.

GOLD Production From **QUICKSILVER** Details, \$2.95. Dr. Jones, 345 N Ridge, Idaho Falls, ID 83401. Show Wrong: \$200.00 Refund.

GAS LIGHTER "CLIC"
Always ignites! Electric spark without battery. Works forever. Made in Switzerland. 5 years guarantee. Ideal for gas cooking stoves, welding - or propane torches.
Order from: \$16.95
Urs Schuler
12060 Hwy 116
Guerneville, CA 95446
Check, money order, VISA/M.C. No COD's. Thank You!

94 FOR INVENTORS

I Help Inventors. Engine experimenters preferred. Free laboratory machine-shop facilities. Phone 1-314-435-9290.

INVENTORS, introduce your invention to manufacturers. Wilmark Services, 132 Main Street East, Grimsby, Ontario, Canada, L3M 1P1.

REGISTERED PATENT ATTORNEY. Applications and Searches. Mail Service. **FREE** Preliminary Review Of Your Disclosure. Box 392PS, Millwood, New York 10546.

PATENT IT ECONOMICALLY! Free details. N. Rainer, 2008 Fondulac Rd., Richmond, VA 23229.

INVENTION EVALUATION. Have your confidentially disclosed invention objectively evaluated by technical experts. For policy statement and description of services write: **WATERLOO SELF-PATENTING INSTITUTE**, Box 697, Waterloo, Ontario, Canada. N2J 4B8

BEFORE YOU ACT - GET THE FACTS Society of American Inventors, Rte. 4, Box 419-F, Savannah, GA 31405.

WASHINGTON AREA PATENT LAW FIRM assists inventors seeking patent protection. For information, write: 9359-S Torrent Row, Columbia, MD 21045.

INVENTORS: If you have an invention for sale or license, write for free booklet explaining how we can help you. Kessler Sales Corp., C-76-FI, Fremont, OH 43420.

NONPROFIT FOUNDATION HELPS INVENTORS. WIDEST RANGE OF SERVICES. FREE RECORDING FORMS. FREE EVALUATION, AFFILIATED INVENTORS FOUNDATION, 501-A IOWA, COLORADO SPRINGS, CO 80909.

IDEAS, INVENTIONS NEW PRODUCTS WANTED! Marketing assistance available to individuals, universities, companies. Write for Kit-PS. **INVENTION MARKETING, INC.** 701 Smithfield Street Pittsburgh, PA 15222

95 INVENTORS WANTED

MANUFACTURER SEEKING INVENTIONS. ADVANTEK INTERNATIONAL, 1100 17th NW., WASHINGTON, DC 20036.

INVENTORS: Free information on offering your invention for sale. Kessler Sales Corporation, C-76-IW, Fremont, OH 43420.

INVENTIONS-PRODUCT IDEAS WANTED!
INVENTORS! RECEIVE A SECOND INCOME for just one invention or new product idea with a reasonable marketing potential. No idea too small. Patent not necessary.
LICENSING AGREEMENT OR OUTRIGHT PURCHASE GUARANTEED for any invention or new product idea accepted for manufacturing and marketing. For FREE Booklet and complete information, write to:
TRANS-WORLD EXPORT CORPORATION
28829 Chagrin Boulevard • Suite 109A
Cleveland, Ohio 44122

INVENTIONS WANTED

FREE CONSULTATION • NO IDEA TOO SMALL Disclosure registration. Potential cash or royalties from manufacturers seeking new ideas. For free information on how to register your ideas. Call or Write

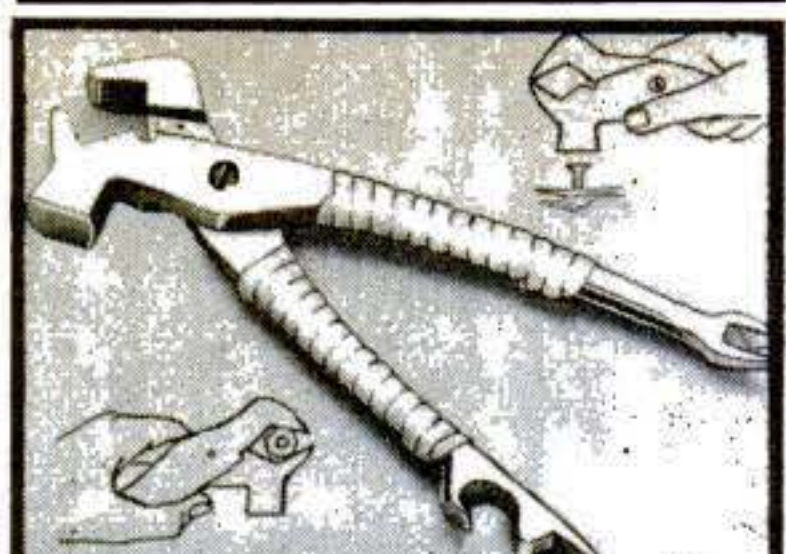
American Inventors Corp.
59 Interstate Dr. Dept PS
West Springfield, MA 01089 (413) 737-5376
A Fee Based Marketing Company

97 GOOD EATING

PEANUT BUTTER LOVER'S PEANUT BUTTER BOOK or 25 Ways To Enjoy Peanut Butter! Send \$3.95 check or money order to: 21 & Company, P.O. Box 7549, Burbank, California 91510-PS. 30 day money back guarantee.

SPICES 45% OFF Supermarket prices. Send stamped envelope: Exim Overseas, Box 8147, Union City, NJ 07087.

99 FOR SALE MISC.



A TOOL KIT IN THE PALM OF YOUR HAND 7-in-1 TOOL

Seven most useful and most used tools. Combined in one handy, husky tool. Hammer, Wrench, Pliers, Screwdriver, Wire Cutter, Tack or Nail Puller and Bottle opener all in one. Compact 8" chromed steel. Built for generations of service.

Insulated handle for safe, steady grip. Tucks away in kitchen or desk drawer, glove compartment or boat emergency kit.

Only \$3.98 + 95c postage & handling. 2 for just \$6.98 + \$1.75 post. & hdlg. (Add applicable sales tax in AZ, CA, CO, FL, IL, NY, PA, VA, VT, WI). Send check or MO to:

TMM 7-Way Tool
Dept. PS061, PO Box 9569
New York, N.Y. 10249

100 WANTED TO BUY

QUICKSILVER, platinum, silver, gold! Ores analyzed. Mercury Terminal, Norwood, MA 02062.

SCRAP SILVER ELECTRICAL CONTACTS, Forklift Contacts Industrial Scrap Silver, Sterling, Silver Solder, Gold Plate. Send sample for my offer. All samples Returned. Robert Leszczak, 652 Myrtle St., Elizabeth, NJ 07202.

102 TREASURE FINDERS, METAL DETECTORS

GOLD, SILVER! Find Valuable Coins, Rings, Jewelry with powerful metal detectors. Free catalog: Gold Mountain, Box 40507-X, Garland, TX 75040.

FIND old coins, jewelry, gold nuggets. New patented revolutionary device. Free catalog. Gardiner, 4729L N. 7th Ave., Phoenix, AZ 85013.

BURIED TREASURE
Locate from a LONG DISTANCE with Ultra Sensitive **DIRECTIONAL** Locator
SEND FOR **FREE INFORMATIVE BROCHURE**
RESEARCH PRODUCTS
BOX 270270-H TAMPA, FLORIDA 33688

104 VACATIONS, RESORTS, TRAVEL

HAWAII CONDOMINIUMS. Resorts/Rates/Golf/Tennis. Enclose \$1.00 Postage. 9000 Sunset, #506-PS, Los Angeles, CA 90069.

105 MISCELLANEOUS

ORNAMENTAL Iron designs. Book of 1600 beautiful, practical designs for railings, columns, etc. Free literature. Cunningham, 3881 South 3200 West-P.O. Box 20005-S, Salt Lake City, UT 84120.

Carry Glasses, Pen or Pencil in this easy-to-reach HOLSTER
End the nuisance (and expense) of glasses falling out of your pocket when you bend down; of misplacing glasses when you need them most. Or, not having pencil or pen handy when you want it. End bulging pockets, too — or ink-stained shirt and jacket pockets.
Handy quick-draw belt holster will carry your glasses and pen at the ready, and out of the way, right on your belt. Especially designed for every size or shape of glasses (sun glasses, too), and for easy in and out carrying and removal.
Leather-grained plast-o-hide for long wear. Lined inside to protect and clean lenses.
A lifetime value at only \$2.98, plus 75c postage & handling. Residents of AZ, CA, CO, FL, IL, NY, PA, VA, VT, WI add applicable sales tax. To order, send check or money order to:
TMM HOLSTER, Dept. PS061
Box 9569, Church St. Sta., New York, N.Y. 10249

FREE BOOK. Prophet Elijah Coming Before Christ. Megiddo Mission, Dept. 58, 481 Thurston Road, Rochester, NY 14819.

BEEF stick salami recipe - \$1.00 and SASE, Dept. 18, Box 3834, South Bend, Indiana 46619.

PROSPECT/SPECULATE Nova Scotia **GOLD** \$5.00. Cameron, RR 2, Mill Village, Nova Scotia B0J 2H0.

Precision Pocket Scale
Saves postage. Unique and useful. Great gift for everyone who mails letters! Shows ounces and grams. Comes with carrying case, stamp pocket and postage rate card. Even desk or briefcase needs one. \$3.50 plus 45c for postage and handling. Satisfaction guaranteed. Order today!
CanMont Group, Inc.
P.O. Box 886286
Atlanta, Georgia 30338

105A HEALTH

NEW WORLD DISTILLERS. Give you the purest water possible. Lowest prices. N.A.H.P., 423 Mill St., Worcester, MA 01602.

HEART ATTACK PREVENTION — Right food is best medicine. Proved by Famous U.S. medical school and medical journal. For recipes and reference information send \$3.00 to: Kochey Co., P.O. Box 438, Fresh Meadows, NY 11365.

106 PERSONAL

INVESTIGATORS. Latest Electronic Aids. Write: Clifton, Box 220-F, Miami, FL 33168.

ADVANCED TITLES/DEGREES Ministers, Honorary Doctorates, other Services available. Omnidenominational. Free Details. Acquarian Church, 432-PS PCH, Hermosa Beach, Ca 90254.

DIVORCE? Don't lose! Literature, Attorneys. **MEN'S RIGHTS ASSOCIATION**, 189A, Forest Lake, MN 55025.

A COMING Whirlwind to sweep this earth! Free Information! Write: Harvest, PS, Jefferson City, MO 65102.

PHOTO IDENTIFICATION CARD sealed in plastic. Free engraved metal social security plate. Send \$5.00, photo, name address, weight, height, color eyes, hair social security number. AA Identification Service Corp., Box 2656-Dept. 2, New York NY 10163.

PHOTO ID. Sealed in plastic. All states, provinces. 24-hours. Guaranteed. Free birth certificate. Send \$5.00 (2/\$8.00), photo, name, address, height, weight, hair, eyes, birthdate. Cardinal, Box 5200-DRCC257, Jacksonville, Florida 32207.

ANALYST will solve your problem! Send \$10. Dr. Adan, Ms.D., Box 383, San Pedro, CA 90731.

UNIVERSITY DEGREES BY MAIL. Legal, Fast, inexpensive. Free revealing details. Counseling, Box 389-SP7, Tus-tin, CA 92680.

107 HEARING AIDS

HUGE SAVINGS. Eliminate dealer markup. Free Trial. Batteries wholesale. Terms Arranged. Lloyds-PSC, Rockford, IL 61104.

HEARING AIDS
1/2 PRICE CATALOG FREE!
| **SUPER SAVINGS!** Newest, Finest. All types. Buy DIRECT & save up to HALF! No salesmen. Sold by | **AIR MAIL on HOME TRIAL. FREE** | **Catalog.** Write: **MONEYSAVERS,** | Dept. PS-6D, 9530 Langdon Ave., | Sepulveda, Cal. 91343 | **Not sold in California.**

Booklets, catalogs, and folders listed below provide reliable information, illustrations, and specifications to help you in planning the purchase of a variety of products or services offered by these dependable companies. The convenient order form will save you time and postage.

601 B.A.E.'s Turbocharger Catalog illustrates the EPA-certified Rabbit Diesel Turbocharger, capable of providing over 60 mpg. It also includes many other true bolt-on systems available for most popular gas or diesel versions of foreign or domestic cars. \$3

602 Handyman Products This 103-page color booklet from Black & Decker displays a complete line of consumer products, such as power tools and accessories, trade tools, and lawn, garden, and household products. \$1

603 Dome Homes Information package comprises a plan book featuring 42 pages of facts and photos describing various dome homes and a 12-page plans book containing 50 different floor plans for Cathedralite Homes. \$5

604 Wall Paneling A 28-page brochure illustrates decorating and remodeling suggestions for a variety of Champion panels. Also included: a color-scheme selection chart and installation instructions. 50¢

605 Energy-Saving Instruments Flyer from Condar tells how to save energy with wood or coal stoves and oil or gas furnaces. Suggestions include hi-temp magnetic thermometers, draft gauges, and heat fins. Free

606 Lawn & Garden Tractors Full-color pamphlet examines tractor features, accessories, and attachments, and includes a handy specifications chart. From John Deere & Co. Free

607 Outdoor Footwear Leaflet highlights nationally famous Dunham Duraflex waterproof leather boots. Walking shoes, hikers, field and sport boots, and children's footwear are also featured. \$1

608 Auto-Theft Alarm Literature introduces an alarm for auto, van, or truck that will blow vehicle horn or actuate electronic siren or RF transmitter. Can be mounted to pin switches on hood or trunk. From Delta Products. \$1

609 Power Tools A color leaflet from Dremel shows a full array of power tools for do-it-yourselfers, hobbyists, and crafts people—a tool for almost any project. Free

610 Intake Manifolds Informative catalog from Edelbrock contains 48 pages displaying easy-to-install replacement intake manifolds for street and recreation vehicles, installation accessories, re-useable air filters, and a new electronic water-injection system. \$2

611 It Pays to Own a Used Car Brochures offer tips for motorists who own or are in the market for a second-hand automobile. Also includes car-care tips. From Fram Corp. \$1

612 Do-It-Yourself Furniture Projects manual provides complete instructions for 13 different handyman projects designed to be crafted with Formica-brand decorative laminate. \$1

613 Rechargeable Batteries Consumer brochure from General Electric describes rechargeable nickel-cadmium batteries—economical alternatives to throwaway batteries. Free

614 Hahn Mowers and Riding Tractors Gravelly's pamphlet illustrates and describes both push and self-propelled lawn mowers and eight- to 11-hp riding mowers. Free

615 A Gold Mine in Auto Accessories 68-page catalog shows the latest in auto accessories—from the elegant and exclusive to the practical and distinctive. From Vilem B. Haan. \$2

616 Portable Saw Table Flyer describes this portable folding saw table, capable of giving a circular saw the accuracy of a bench saw. It accommodates most routers and sabre saws, too. From Hirsh Co. Free

617 Keep Cool This Summer Hayden brochure offers information on protective cooling for a car's engine. It's designed to save energy, money, and aggravation. Free

618 Bathroom Becomes a Spa Literature features personal-care showers with systems that bubble, tingle, pulsate, and adjust to anybody's height. From Interbath. 25¢

619 The Traveling Photographer Compact manual from Minox gives handy tips intended to help capture those once-in-a-lifetime pictures, whether at home or abroad. Free

620 Lakota Knives Catalog displays a full assortment of hunting, fishing, and camping knives. It also includes a full-color poster, specifications, and prices, and shows various grips for field use. \$1

621 Kitchen-Planning Guide Merrilatt Industries provides the do-it-yourselfer with 16 pages of hints for planning new kitchens or remodeling existing ones. Includes measuring techniques, cabinet designs, planning for symmetry, special cabinet features, a grid sheet, and layout instructions. \$1.50

622 Insulate Your Attic Booklet tells how to accomplish the job of insulating an attic—the first place to consider insulating in order to save home heating and cooling costs. From Mineral Insulation Manufacturers. 40¢

623 Boat Buyer's Guide This 24-page guide from Mercury Marine includes a wealth of tips and hints, such as what to look for in a boat, how to get the best value, financing information, and much more. 25¢

624 Microcassette Tape Recorder Literature details Olympus Corp. of America's amazing miniature cassette recorder, as well as various accessories. Free

625 Knife Making and Collecting Schrade Cutlery's informative literature offers interesting reading on this unique, exciting hobby. Free

626 Roofing with Cedar Leaflet shows how to save by applying a cedar shingle or shake roof right over the old house roof. From Red Cedar Shingle & Handsplit Shake Bureau. 10¢

627 Firewood Facts A 30-page booklet from Stihl contains tips for selecting, cutting, and seasoning good firewood. It includes a tree-identification guide. 50¢

628 Insulating Plaster Pamphlet from Thoro System Products illustrates the uses and advantages of this cement-base plaster insulating system for exterior walls. Free

629 Home Health Spa Full-color brochure describes the benefits of ThermoSol's luxurious family health spa, which includes steam bath and hydro-massage whirlpool bathtub with gliding vapor-proof Thermo-Door enclosure. Easily installed, spa replaces a standard tub in the same bathroom space. Free

630 Play Olympic Golf Whispering Palms Golf and Country Club in Rancho Santa Fe, Calif., offers a new playing-range concept to help you sharpen your shot-making skills. Free

FILL IN COUPON AND MAIL TODAY

POPULAR SCIENCE P.O. Box 322, Dalton, Mass. 01226

Note: Popular Science Massachusetts address is for Product Information only. Subscription inquiries should be directed to the address at the foot of the table-of-contents page.

Please send the items checked below. I am enclosing 50¢ handling charge (any number of items) plus amount required for priced items.

- | | | | | | |
|----------------------------------|----------------------------------|----------------------------------|----------------------------------|-------------------------------------|----------------------------------|
| ☐ 601 \$3 | ☐ 606 | ☐ 611 \$1 | ☐ 616 | ☐ 621 \$1.50 | ☐ 626 10¢ |
| ☐ 602 \$1 | ☐ 607 \$1 | ☐ 612 \$1 | ☐ 617 | ☐ 622 40¢ | ☐ 627 50¢ |
| ☐ 603 \$5 | ☐ 608 \$1 | ☐ 613 | ☐ 618 25¢ | ☐ 623 25¢ | ☐ 628 |
| ☐ 604 50¢ | ☐ 609 | ☐ 614 | ☐ 619 | ☐ 624 | ☐ 629 |
| ☐ 605 | ☐ 610 \$2 | ☐ 615 \$2 | ☐ 620 \$1 | ☐ 625 | ☐ 630 |

Name (please print) _____

Address _____ City & State _____ Zip _____

Please send cash, check, or money order made out to Popular Science. No stamps or foreign currency. Allow approximately six weeks delivery.

THIS COUPON EXPIRES AUGUST 31, 1981

I AM ENCLOSING

\$_____ for priced items

50¢ for handling

\$_____ TOTAL REMITTANCE

POPULAR SCIENCE JUNE 1981

If the rot's got 'em, it's time to replace your porch columns

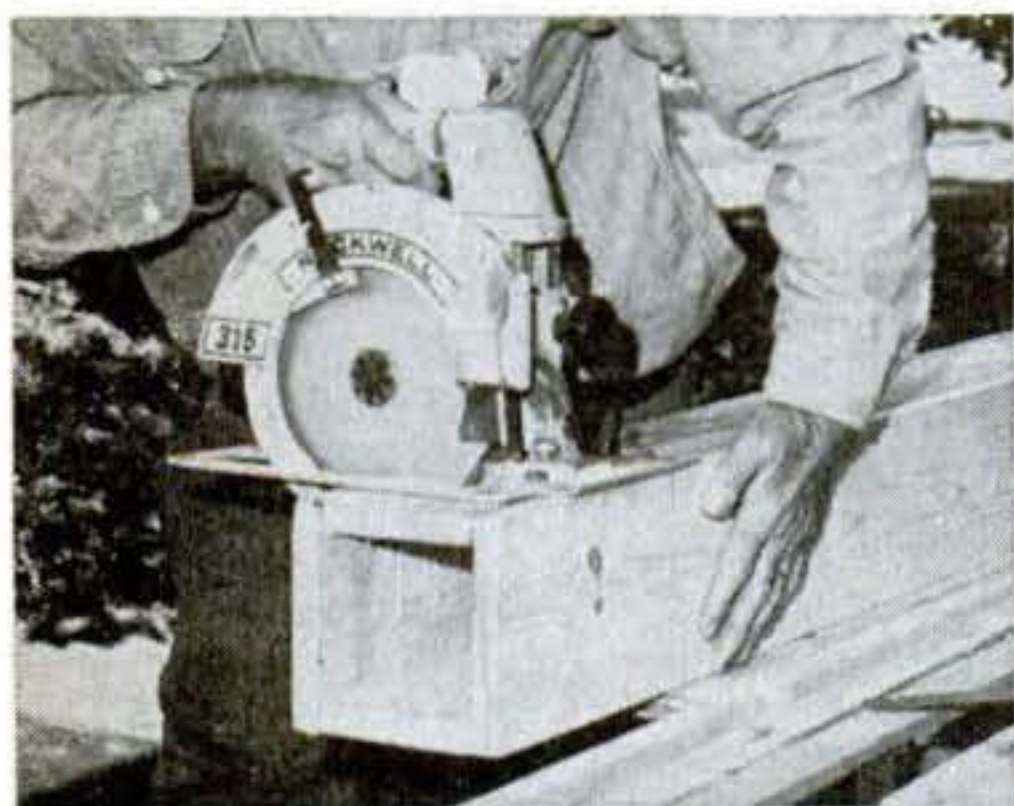
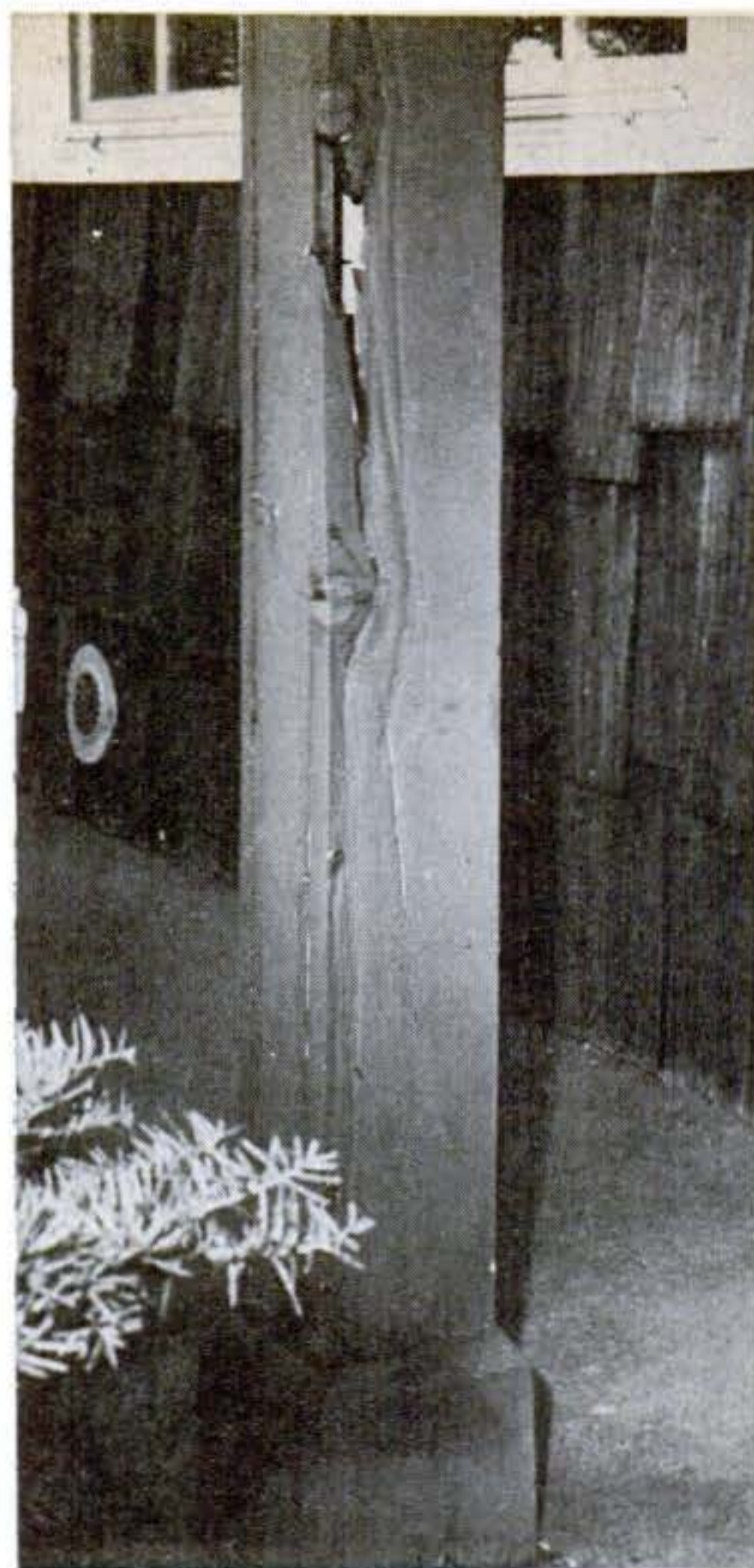
By STEFAN E. BRETT

If your house has a porch that sports decorative wooden columns, they're the first feature you and your guests see when approaching the door.

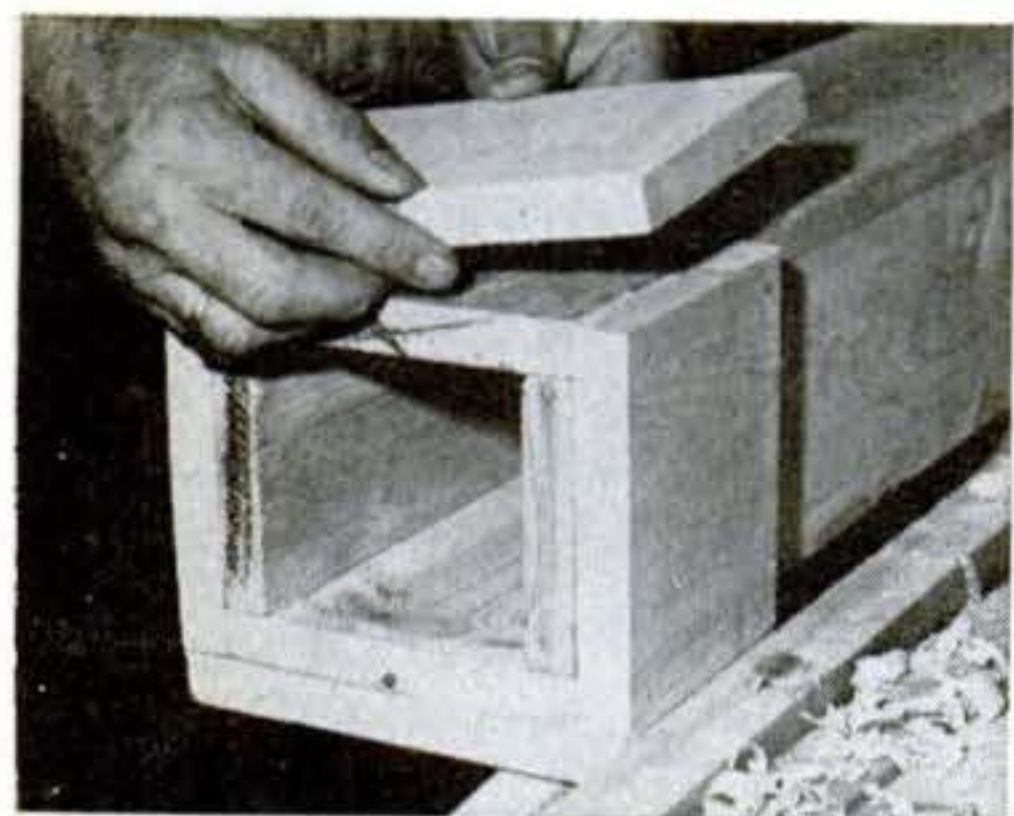
My house has such a porch, and though it's not very old, the columns were made of wood that had not been treated with a preservative, beyond a few coats of house paint. Consequently, the columns were rapidly rotting away—giving guests a poor first impression. When one blew down in a storm, I decided to try for a long-term solution to the problem instead of a cosmetic patch-up.

With a little time and a little lumber, I built replacement columns for the entire porch. I used Wolmanized lumber to avoid rotting problems in the future. Since the porch columns are non-load-bearing (they simply nail to the roof overhang), the project was surprisingly easy, as these photos show. I had new columns up and painted in a weekend. **15**

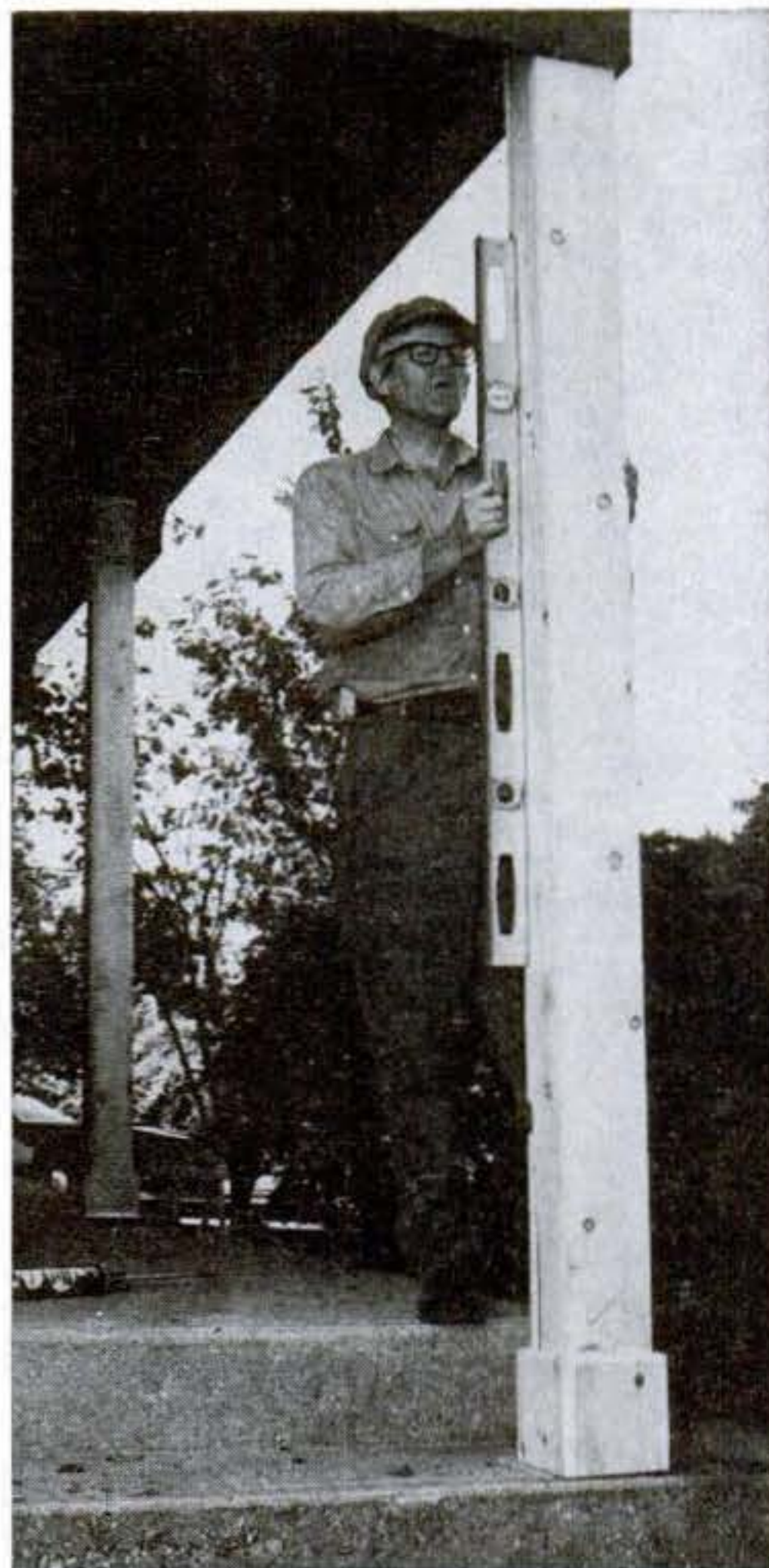
Gaping hole in an old porch column shows how badly rotted the wood was. A neighboring column was in worse shape: It was rotted away completely and blew down in a storm. To avoid such a hazard, replace columns when rot first appears.



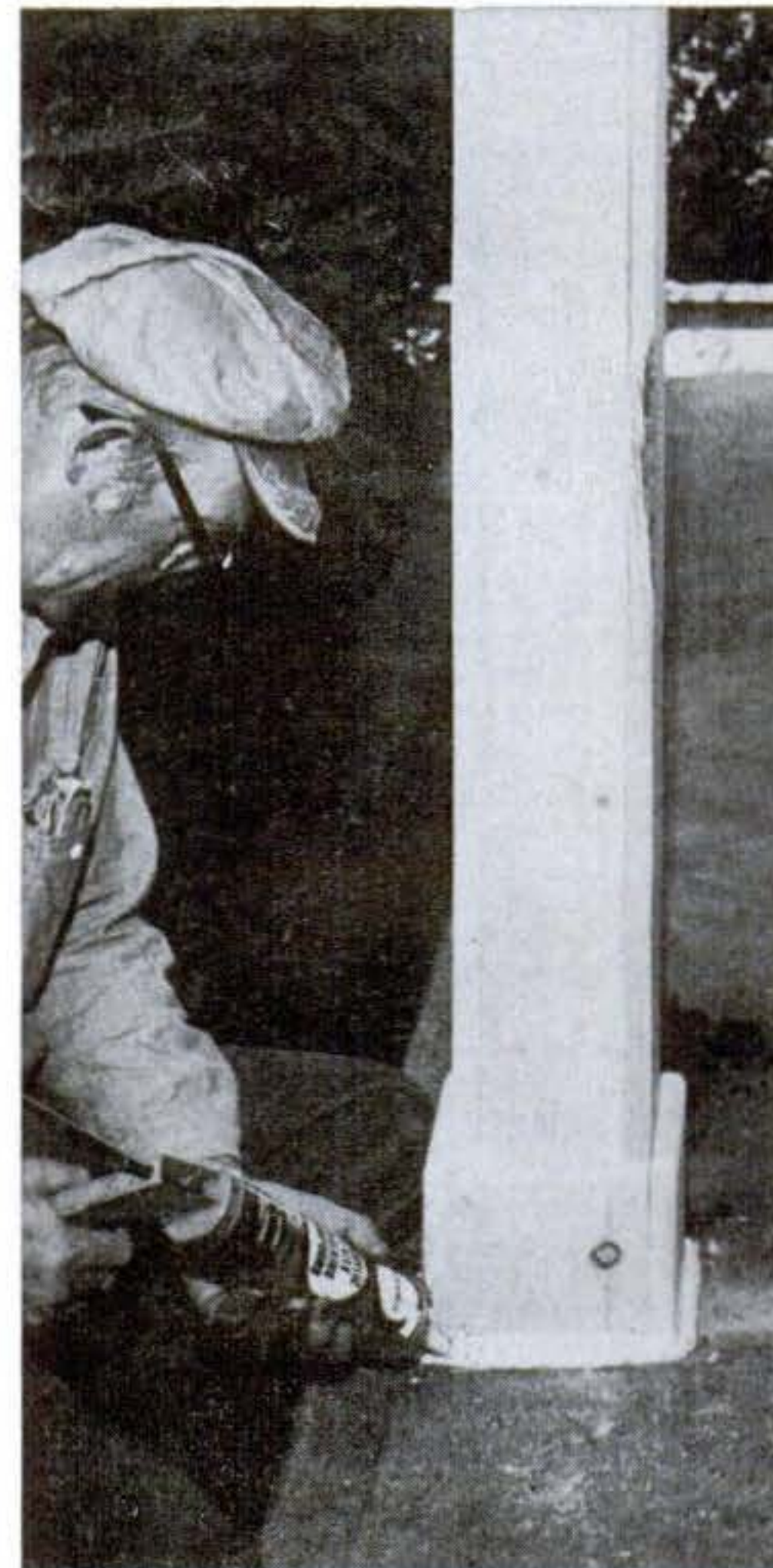
Replacement columns were assembled by nailing together four eight-ft.-long 1×8's, using treated lumber to avoid future rotting. The columns were built a bit long; then they were fitted and trimmed at the bottom with a circular saw.



Simple decorative molding for the base of each column was made by nailing pieces of 1×10 treated lumber on each side of the column's four faces. The columns were sanded smooth, and all cut ends were treated with a wood preservative.



Author used a level to make sure each column was exactly vertical. Installation is easier if you recruit a helper to hold the column in position while you nail its top to the roof overhang. Column in back has already been nailed in place.



A bead of latex caulking was run around the base of each column to form a water-proof seal between the column and concrete porch floor. This further protects lumber ends from rot-provoking moisture. Painting completed the job.

TTED CANADIAN WHISKY · A BLEND · 80 PROOF · CALVERT DIST. CO., N.Y.C.

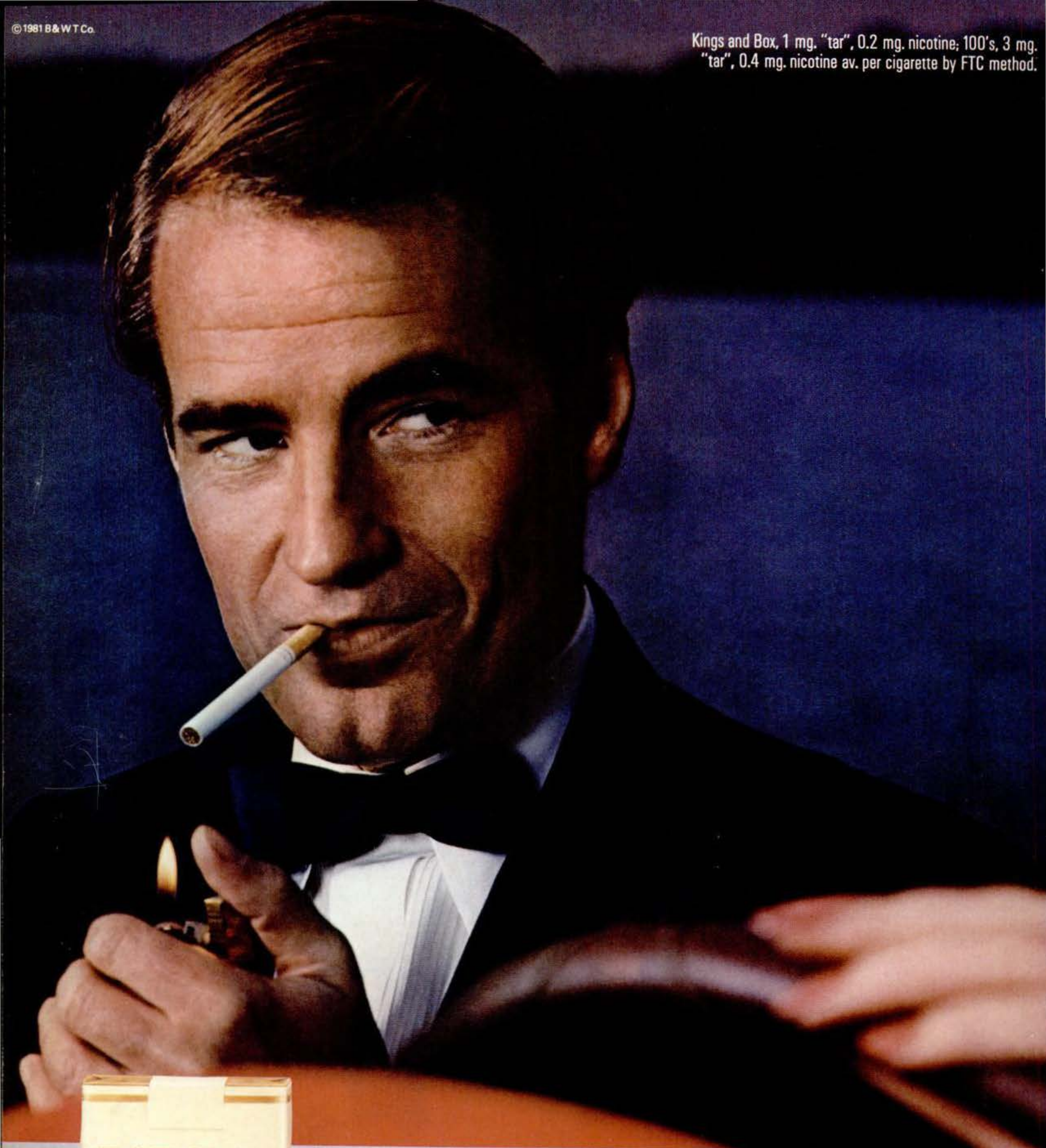
Ride 'em, Calvert. A Canadian that stays on top, thanks to the efforts of four great distilleries from Manitoba to Quebec, who just won't settle for second best. Lord Calvert: Lord of the Canadians.



Lord of the Canadians

Copyrighted material

Kings and Box, 1 mg. "tar", 0.2 mg. nicotine; 100's, 3 mg. "tar", 0.4 mg. nicotine av. per cigarette by FTC method.



The pleasure is back.
BARCLAY

99% tar free. TM

Also available in 100's and Box

Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health.

Copyrighted material